Chapter 3

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Canaan Valley National Wildlife Refuge

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Introduction

This chapter describes in detail the physical, cultural, socioeconomic, biological and administrative environments of Canaan Valley National Wildlife Refuge (Canaan Valley refuge; refuge) and its surrounding environs. It relates those resources to our refuge goals and key management issues, and provides context for our management direction, which we present in chapter 4.

Physical Environment

Elements of the physical environment considered include climate, hydrology, geology, soils, and contaminants.

Climate

The climate is cool and moist resulting from the geography and elevation of the valley. Temperatures are lower than those recorded in the surrounding areas. Canaan's average annual temperature is 45°F. During the winter, the temperatures in Canaan Valley are consistently below 38°F average and can reach below -20°F on occasion. Summer temperatures average between 75°F and 80°F. With an average elevation of 3,200 feet above sea level and mountains that ring the valley, a frost pocket can develop where the cold moist air becomes trapped in the valley. As a result, frost can occur throughout the summer months creating a brief growing season more typical of areas farther north. Temperatures in the 20's (F) have been recorded in all summer months (Leffler 2002).

Due to the valley's location along the ridge of the Allegheny Mountains, precipitation is enhanced from orographic lifting events. Moist air is forced up over the high ridge of the Alleghenies which creates heavier precipitation within the valley than in surrounding areas. Annual precipitation in Canaan Valley averages 55 inches. Precipitation is rather evenly distributed during the year, with the driest months typically occurring in September and October. June is usually the wettest month of the year typically averaging 5.4 inches of precipitation. On average, 4.46 inches of precipitation fall each month. Out of the total precipitation, a significant portion falls as snow in Canaan Valley. Annual snowfall on the valley floor averaged 134 inches for the period of 1961-1990 (Leffler 2002).

Canaan Valley is currently the subject of an intensive climate study conducted by the National Oceanic and Atmospheric Administration (NOAA). Recent research shows that the valley is impaired by both wet and dry sulfuric and nitric acid precipitation as well as high levels of ozone pollution. Acid precipitation in the Canaan Valley during the fall and winter of 2000-2001 averaged 4.3–4.4 pH.

Hydrology

Fresh water

The main water body in the Canaan Valley is the Blackwater River. The headwaters of the Blackwater originate within the Canaan Valley Resort State Park (State Park) and flow north exiting out of the valley on the western gap between Canaan and Brown mountains. Cabin Mountain, forming the eastern watershed boundary of the Valley, also forms the drainage divide between the eastward-flowing Potomac and northwestward-flowing Cheat River.

In Canaan Valley the Blackwater River gradient is approximately 3.7 feet per mile. Its gradient between Canaan Valley and Davis is approximately 17.6 feet per mile. Annual average flow of the Blackwater River is 191 cubic feet per second (cfs).

Tributaries to the Blackwater enter along its course through the valley and many of them flow through the refuge. These tributaries include the Little Blackwater River, Glade Run, the North Branch, Sand Run, Yokum Run, and Freeland Run. Additionally, numerous unnamed small streams and springs feed the Blackwater as it travels through the valley, adding to its size. The Blackwater River and its major tributaries are low gradient streams on the refuge.

There are numerous springs and seeps throughout the refuge that create wetlands and small ponds. Extensive wetland complexes occur in the northern portion of the refuge. These wetlands comprise the largest wetland aggregation in the State of West Virginia. Beaver activity has impounded drainages on the refuge to create ponds of various sizes. Old beaver ponds have developed into palustrine wetlands and bogs. Beaver ponds have increased over the years as beaver populations swelled. Analysis of aerial photography found 113 beaver ponds in 1945 and 222 in 2003 (Bonner 2005, 2009).

There are four ground water aquifer zones in Canaan Valley identified as the Pottsville/Mauch Chunk, Greenbrier, Greenbrier/Pocono and Pocono. Wells drilled in the valley range from 105 feet in the valley floor to over 260 feet in the Pocono aquifer on the hilltops of the valley (Kozar 1995).

The importance of the North Branch was also studied by Kozar (1995) who notes the 5.5 mi^2 North Branch drainage was an important source for ground water recharge for Canaan Valley due to its large drainage area. The southern portion of the valley was found to have a more significant role in ground water recharge compared to the north end of the valley. This was mostly attributed to the permeability of the limestone geology that underlies certain drainages in the southern end of the valley (Kozar 1995).

The majority of the fresh water used is withdrawn by the State Park and Timberline Four Seasons Resort. The State Park pumped over 144 million gallons of surface water from the Blackwater River for park operations during 1992 (including operation of the ski resort and golf course). Timberline Four Seasons Resort used almost 9 million gallons of ground water and 50 million gallons of surface water for operations and snow making during 1990. With increasing development occurring in the southern portion of the valley, ground water use through new well development continues to increase.

Geology

The refuge lies in the Canaan Valley watershed located in the high plateau zone of the Allegheny Mountain section of the Appalachian Plateau physiographic province (Gwinn, 1964). The average elevation of 3,200 feet above sea level coupled with the 35,000 acre watershed makes this area the highest valley of its size east of the Rocky Mountains. The average elevation for the ridges surrounding the valley is 3,900 feet, although several peaks reach elevations in excess of 4,200 feet.

The Canaan Valley was formed by the erosion of the Blackwater Anticline. This created the center "middle ridge" portion of the valley, formed by Pocono sandstone which is the older sandstone formation in the valley. More erosive rock in the center and edges of the valley created depressions surrounding the middle Pocono sandstone ridge. These depressions are what have developed into the wetland areas of the valley. Canaan is underlain by moderately dipping sedimentary rock of the Pocono, Greenbrier, Mauch Chunk, and Pottsville Groups.

Pottsville sandstone forms the ridges surrounding the valley with the younger sandstones, shale and coal of the Mauch Chunk and Pottsville groups lying underneath. The Mauch Chunk seen in exposed sections of the valley as red, fine grained shale occupies the lower slopes of Canaan and Cabin Mountains. Greenbrier limestone underlies most of the valley creating unique wetland communities where their buffering capacity influences water quality.

Soils

The soils of the valley were characterized by the U.S. Department of Agriculture 1967 soil survey report into 19 series and five physiographic categories: uplands, lower slopes, flood plains, and stream terraces and swamps (Losche and Beverage, 1967). The upland sites are characterized as well-drained or excessively

drained. The two major soil associations are Wet Terrace Land-Dekalb-Blago Associations and the Dekalb-Calvin-Belmont Associations. The common soils making up the upper, middle, and lower portions of sloping land and low hills are Dekalb, Calvin, and Belmont. Mecksville soils are characterized as deep and well-drained and tend to occur at the bases of mountain slopes in the valley (Fortney 1975).

Soils in the lower flood plain, stream, and swamp areas are mostly poorly to very poorly drained. The most common soil types in these areas are Blago and Atkins, with Muck and Peat soils occurring most extensively in the Canaan Valley (Fortney 1975). Wet Terrace Land soils include Blago and Atkins series soils as well as other soils in undifferentiated land units. Similarly Muck and Peat soils combine all organic soil types into one category for mapping purposes.

Canaan Valley contains the largest expanse of Wet Terrace Land and Muck and Peat soils in Tucker County. These wetland soils are characterized as organic soils that are either strongly or extremely acidic. Generally these organic soil layers are two feet or more in thickness. Muck and Peat soils are generally flat with a water table at or near the surface most of the year (Fortney 1975).

Environmental Contaminants

Little information exists for environmental contaminants on refuge property. However, in May 2006, Kathleen Patnode, a Service environmental contaminants specialist, conducted a site visit as part of the scheduled Contaminants Assessment Process (CAP). The objective of the CAP is to identify any past, current, or potential contaminants issues on the refuge and to recommend, where necessary, corrective or preventative measures. She visited known or suspected areas of concern and reviewed the property acquisition files for these areas. For all but one area, previous evaluation was limited to a Phase I Contaminants Survey prior to acquisition.

Areas evaluated include a water-pumping station adjacent to the Blackwater River on the Reichle Tract, approximately ten capped natural gas well sites and eight old hunting cabins on the Main Tract, several barn sites where agricultural chemicals may have been stored, and three trash dumps on the Cortland, Reichle, and Harper Tracts. Of these, Patnode felt that only the dump on the Reichle Tract warranted further evaluation based on numerous drum carcasses, waste indicative of automotive repairs, and waste present in a tributary. The refuge plans to request funding to sample the soil, sediment, and water associated with this dump to facilitate removal of the waste. All but two of the old hunting cabins have been subsequently removed in a joint partnership between the refuge and the WVDEP Rehabilitation Environmental Action Plan (REAP) program.

A Phase II Contaminants Survey was performed in 2000 for the active gas well site on Tract 42 prior to the purchase. Diesel fuel oil, waste water (brine), hydraulic fluid, and mercury were identified as potential contaminants. Samples taken from immediately adjacent to and down gradient of the waste water storage tank had low levels of petroleum hydrocarbons and mercury. Patnode noted that an area of dead vegetation still exists between the storage tank and the wetland which may be due to salt toxicity from the brine solution. To prevent migration when the tank is emptied in the future, a berm should be installed around the tank by the well operator.

The primary contamination concern for this refuge is the potential for spills and waste associated with the current and future wells/pipelines or mines as most of the property was purchased without mineral rights. A secondary concern is the atmospheric deposition of pollutants from industries and coal-fired power plants due to the topography, elevation, acid precipitation, and high potential for mercury

methylation within the wetlands. A sample of stream salamanders analyzed for metals contained selenium concentrations of risk for water shrew. Mercury in these salamanders did not pose a risk, but methylation in streams is low compared to wetlands. NOAA mercury deposition data should be evaluated to determine if biota sampling in the wetlands is warranted.

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Lower Idleman's Run

Water Quality

The primary river draining the refuge is the Blackwater River. Seven named tributaries and numerous smaller streams exist throughout the refuge that flow into the Blackwater as it makes its way from the headwaters in the State Park to the Canaan-Brown Mountain gap where it exits the valley and the refuge. The refuge contains the headwaters area of the Little Blackwater River and Glade Run as well as most of Idleman's Run and Freeland Run. Additionally, land acquisition in 2005 and 2008 protected much of the North Branch River and Flat Run, important tributaries and circumneutral wetland corridors in the south end of the valley.

Increased development in the southern portion of the valley has heightened concerns of water quality and availability in the Blackwater River. Wastewater from recreational and other developments is typically treated with aeration plants, lagoons, or individual septic tanks. In 1998 there were three wastewater facilities that discharged directly into the Blackwater River. There were 12 additional wastewater facilities that discharged directly into tributaries of the Blackwater. Currently there are plans to create new centralized, shared wastewater treatment facilities to upgrade current systems and allow growth of developed areas.

Ground water quality was described as being primarily influenced by the mineral composition of the source rock with septic discharges and agricultural land use practices influencing it to a lesser extent (Chambers et al. 2002). Within ground water samples, commonly detected contaminants were bacteria, radon, and manganese. However, most ground water samples taken during a U.S. Geological Survey 1991 survey did not exceed U.S. Environmental Protection Agency (EPA) standards (Chambers et al. 2002).

With increasing development in the southern portion of the valley, more water will be removed from the watershed. Importantly, surface waters removed during the summer and fall low flow periods may impact aquatic resources. According to Kozar (1995) "In excess of one-third of available surface water resources is being used during low flow period" in the valley. Impacts of this use are obvious on Idleman's Run, which flows dry in late summer and early fall and also harbors a productive brook trout fishery. A water diversion removes surface water from the upper reaches of Idleman's Run to supply water to an emergency snow making pond at a development on Timberline Road. This exacerbates low water flow, increased stream temperatures, and direct loss of habitat for brook trout populations on the refuge during the fall breeding season. As development increases in the valley, water resources will likely continue to be tapped and impacted in both quantity and quality.

Water quality analysis has been conducted primarily in the main stem of the Blackwater River within Canaan Valley. Early testing (1970's) was conducted to

develop base line conditions to measure change against if the hydroelectric project was completed by Allegheny Power. Testing was also conducted to evaluate impacts to water quality by developments such as the State Park and Timberline Four Seasons Resort.

Most recently, water quality has been studied by the USGS and the West Virginia Division of Environmental Protection for the development of total maximum daily load limits. The Blackwater River was found to have dissolved oxygen limit levels below the recommended as a State minimum for a trout fishery (6.0mg/l). This problem was attributed primarily to municipal point sources in the valley; however beaver ponds and wetlands upstream from the sampling site have also been implicated in reducing dissolved oxygen levels in the Blackwater (Environmental Protection Agency 1998).

The Service and USGS conducted a study of the effects of off-road vehicle use on water quality of the Blackwater River in 1993. This particular study was designed around an off-road vehicle race which brought hundreds of participants into the Canaan Valley and lower Blackwater River drainage. Samples were collected before, during, and after the race and analyzed for dissolved oxygen, suspended sediment, fecal bacteria concentrations, pH, and turbidity. This study found increases in suspended sediment concentrations, turbidity, and fecal bacteria concentrations related to the off-road vehicle activities, particularly around camp areas, within the Blackwater River. (USFWS 1993).

According to Snyder et al. (2002) acid rain may be having an important impact on stream quality in Canaan Valley. Due to the sandstone geology in the higher elevation streams and the low pH of precipitation (3.86-4.41 in 1995-1996), it was estimated that almost half of all streams and ponds in Canaan Valley would not support brook trout (Snyder et al. 2002). According to some studies, the lower limit of brook trout embryo and hatchling survival is a pH of 4.5. Streams that occur in the lower elevations of the valley can be influenced by the Greenbrier limestone which can offset and buffer low pH waters and create suitable brook trout habitat.

Unexploded Ordnance

The presence of unexploded ordnance—left over from military training activities during World War II—on refuge property was thought possible due to the confirmed presence of ordnance in both the Dolly Sods Wilderness area to the east of the refuge and the Canaan Valley Institute property to the west of the refuge. This possibility was confirmed when a live 105mm artillery round was found by a hunter on refuge property during the spring of 2007. After consultation with the Army Corps of Engineers and a review of historic maps, it became evident that the target areas used by the military during the war included areas now part of the Canaan Valley refuge, well down slope from the ridgeline closer to the Dolly Sods Wilderness Area.

The extent of what is now the refuge that was actually used for target practice activities is unknown. The only information available is in historical maps indicating potential target areas and the actual live round found in 2007. No other ordnance has been found; however, the Army Corps of Engineers has not yet conducted a comprehensive sweep of known bombing target areas on refuge property.

The refuge currently partners with NOAA to provide a site location for an air monitoring station. The station, located on the Beall Tract of the refuge, is part of the Atmospheric Integrated Research Monitoring Network and is part of the National Atmospheric Deposition Program. The purpose of this monitoring site is

to collect data on atmospheric wet and dry deposition along with other air quality data. The station has been operational on refuge property since 2000.

Monitoring activities include ozone levels in the Canaan Valley. Overall air quality is good, with no current criteria pollutants exceedances, but of recent concern is ground level ozone which has exceeded the EPA 8-hr standard (75 ppb) for safe health levels on 1-5 days per year from 1995 to present. Ozone has been cited as not only important in protecting human health but also as a direct threat to vegetation and plant communities in the eastern United States (U.S. Environmental Protection Agency, 1996). Ozone levels were found to be in excess of the 8 hour standard (>0.08ppm) in Canaan Valley during the years 1995-1999 at a monitoring site on Bearden Knob on the southwestern side of the valley. Additionally the levels of ozone detected at this site exceeded levels considered harmful to wide ranges of vegetative communities (Edwards et al. 2004).

Regional Economic Setting

The Canaan Valley region is a unique mountain valley, with habitats, plants, and animals typically found at higher latitudes. The refuge works to preserve unique wetlands and uplands of this high elevation, moist valley (USFWS 2006b). Canaan Valley refuge is located in Tucker County, West Virginia, in the northeastern portion of the State known as the Potomac Highlands Region. In 1994, with the purchase of 86 acres, Canaan Valley refuge became the nation's 500th refuge. Currently, the refuge consists of over 16,000 acres. Over 8,932 additional acres are within its acquisition boundary. The acquisition boundary encompasses most of the wetlands and unique habitats of the valley. Acquisition will continue, dependent on willing sellers and availability of funds.

The refuge is within a few hours' drive of several large metropolitan areas including Pittsburgh and Harrisburg, Pennsylvania, Washington, D.C., Baltimore, Maryland, and Charlottesville and Richmond, Virginia (Tucker County Convention and Visitors Bureau, 2008). For the purposes of an economic impact analysis, a region (and its economy) is typically defined as all counties within a 30–60 mile radius of the impact area. Only spending that takes place within this local area is included as stimulating changes in economic activity. The size of the region influences both the amount of spending captured and the multiplier effects. While the refuge is located in Tucker County, the city of Elkins (located in adjacent Randolph County) is economically important to the refuge as well. Most of the refuge personnel live in Elkins, and approximately twenty five percent of the refuge non-salary purchases are made in Elkins. Randolph County is the largest county in West Virginia with a total area of 1,040 square miles (U.S. Census Bureau, 2008). Elkins is located in the northern tip of Randolph County, 34 miles southwest of the refuge. The refuge's economic ties to Randolph County do not extend past Elkins. Based on the relative self-containment in terms of retail trade, Tucker County and the city of Elkins were assumed to comprise the local economic region for this analysis.

Population

Table 3.1 shows the population estimates and trends for the regional area and communities near the refuge. In 2000, the city of Elkins and Tucker County were similar in terms of population size with 7,032 residents in Elkins and only a few hundred more (7,321) in Tucker County (U.S. Census Bureau, 2008). Davis, Thomas, and Parsons are the principal communities in Tucker County located near the refuge. In 2000, Tucker County was the third least populated county in the State and accounted for less than one percent of the State's total population (U.S. Census Bureau, 2008). The town of Parsons was the only community that resembled the State's 0.8 percent population growth rate, with a 0.7 percent population increase from 1990-2000 (U.S. Census Bureau, 2008). Elkins and Tucker County experienced population declines of approximately 5 percent between 1990-2000 while the smaller communities of Davis and Thomas experienced larger declines of over 21 percent (U.S. Census Bureau, 2008).

Table 3.1. Local and regional population estimates and characteristics.

	Population in 2000			Population change (%)
	Residents	Persons per square mile	Median age	1990 to 2000
West Virginia	1,808,344	75.1	38.9	+0.8
Tucker County	7,321	17.5	42.0	-5.3
communities near refuge				
Elkins (Randolph County)	7,032	2,207.7	38.8	-5.5
Davis (Tucker County)	624	546.0	41.5	-21.9
Thomas (Tucker County)	452	753.6	47.8	-21.1
Parsons (Tucker County)	1,463	1,332.5	39.9	+0.7

Source: U.S. Census Bureau (2008), Census 2000 Summary File (SF-1)

The city of Elkins is located in the heart of West Virginia's Mountain Highlands and serves as the recreation gateway community to the Monongahela National Forest with nearby access to the refuge, State parks, forests, and natural landmarks (City of Elkins, 2008). Situated on a bend in the Tygart Valley River, Elkins was founded by Senators Henry Gassaway Davis and Stephen B. Elkins in 1890 and became the Randolph county seat in 1899 (City of Elkins, 2008). Historically, the area was dominated by agriculture (West Virginia Rails-to-Trails Council, 2002). The senators were responsible for bringing the WV Central and Pittsburgh Railway into Elkins which opened the surrounding territory to development (City of Elkins, 2008). The completion of the railway in the late 1890's made extraction of the large reserves of coal, limestone, shale, and timber resources possible and encouraged industrial development of the area (West Virginia Rails-to-Trails Council, 2002).

Approximately 41 percent of Tucker County, known as the "Top of the Mountain State," is publicly owned land. Parsons, the county seat, is located on the Shaver's Fork of the Cheat River and is home to 1,463 residents. The town was incorporated in 1893 and named for Ward Parsons, a pioneer who owned the land on which the town was built (West Virginia Rails-to-Trails Council, 2002). Davis, the highest incorporated town in the State at an elevation of 3,200, consists of 624 residents. The town has a longstanding tradition with the lumber industry and was known in its early years as "Canada," due to its dense forest of spruce and hardwoods (Town of Davis, West Virginia, 2006). Thomas, home to 452 residents is only 2.5 miles from Davis. Like many towns in the region, Thomas has its roots in the coal industry. By 1892, Davis Coal and Coke was one of the largest coal plants in the world, employing 1,600 people in Thomas (Tucker County Convention and Visitors Bureau, 2006).

The Census Bureau (2008) reports that in 2000, West Virginia's population consisted of 95 percent white persons not of Hispanic or Latino origin. Tucker County (98.9 percent), and the communities of Elkins (96.9 percent), Davis (97.9 percent), Thomas (98.7 percent) and Parsons (99 percent) all had averages greater than the State average in 2000. The percentage of residents identifying themselves as Black or African American, American Indian or Native Alaskan, and Asian was 2.2 percent in Elkins and less than 0.5 percent in Tucker County (U.S. Census Bureau, 2008). Ancestry patterns across Elkins, Davis, Thomas and Parsons were similar to each other with heavy German, Irish and English influences (U.S. Census Bureau, 2008).

Approximately 71.5 percent of West Virginia residents 25 years and older are high school graduates. Tucker County (75.4 percent) and the communities of Elkins (79.5 percent), Davis (76.7 percent), Thomas (84.5 percent) and Parsons

(77.4 percent) all displayed rates greater than the State average. In 2000, the percentage of residents who held a bachelor or advanced degree was 14.8 percent for the State of West Virginia while the national average was 24.4 percent (U.S. Census Bureau, 2008). Elkins (23.4 percent) exceeded the State average while Tucker County (10.5 percent) and the communities of Davis (9.4 percent), Thomas (10.1 percent), and Parsons (11.8 percent). were all less then the State average (U.S. Census Bureau, 2008).

Employment and Income

Employment estimates (2006) for Elkins, Tucker County, and the State of West Virginia are shown in Table 3.2. Generally, Elkins and Tucker County resembled the State's percentage of employment in each industry. Two main differences were that the employment in the accommodation and food industry in Tucker County was almost 10 percent higher than the State average and Elkins employment in educational, health and social services industries was over 14 percent higher than the State average. Government employment accounted for almost 17 percent of West Virginia's total employment in 2006, a greater percentage than any other sector. Government was also the largest employer in Tucker County and the second largest employer in Elkins in 2006. In 2006, construction, manufacturing, retail trade and the finance, insurance, real estate, and information industries were other main industries providing employment in Tucker County. Other main industries providing employment in Elkins in 2006 were retail trade and the arts, entertainment, recreation, and accommodation and food services (U.S. Census, 2008).

Table 3.2. 2006 full-time and part-time employment for West Virginia, Tucker County and Elkins

	West Virginia	Tucker County	Elkins**
Total non-farm employment (jobs)	860,554	3,697	5,791
Percent of Employment by Industry			
Ag, forestry, fish & hunting	0.5%	(D)*	2.5%
Mining & Utilities	4.4%	(D)*	—**
Construction	6.6%	8.1%	5.3%
Manufacturing	7.1%	8.2%	10%
Wholesale trade	3.1%	(D)*	3%
Transportation & warehousing	3.0%	2.8%	2.7%
Retail trade	12.7%	10.4%	11%
Finance, insurance, real estate, & information	7.4%	7.6%	5.6%
Services			
Professional, management, admin., & waste	9.4%	(D)*	8.2%
Health care, social assistance, & educational	14.0%	11.1%	28.6%
Arts, entertainment, & recreation	1.9%	1.3%	—**
Accommodation & food	7.1%	17.0%	10.2%
Other services	6.2%	7.0%	4.9%
Government (Federal, State, & local)	16.8%	19.0%	17.8%

Source: State and County level data from U.S. Dept. of Commerce, Bureau of Economic Analysis, Regional Economic Information System 2008. Self-employment is not included.

(D): Data suppression. Data not shown to protect confidential information, but the estimates for these items are included in the totals*

***Elkins data from U.S. Census (2008), Arts, Entertainment & Recreation included in Accommodation and food, Mining was not reported*

U.S Census Bureau (2008) data for median household income, unemployment and percentage of persons living below poverty are shown in Table 3.3. As shown in Table 3.3, Tucker County and all the communities included in the study area were below the State and national averages for median household income. The national average unemployment rate in 2000 was 3.7 percent, and West Virginia's average unemployment rate was 4.0 percent in the same year. Thomas (3.6 percent) was the only community in the study area with an unemployment rate lower than the State and national averages. The percent of population below the Federal poverty line is an indicator of the economic distress within a community. In 1999, the national average of individuals living in poverty was 12.4 percent. West Virginia's average was 17.9 percent. Tucker County (18.1 percent) exceeded both the State and national averages. Elkins (14.4 percent), Davis (14.6 percent) and Thomas (13.7 percent) were greater than the national average, but less than the county and State averages. Parsons (18.7 percent) has the greatest percentage of its residents living below the poverty line of the towns in the study area (U.S. Census Bureau, 2008) (Table 3.3).

Table 3.3. Income, unemployment and poverty estimates

	Median Household Income (1999)	Percent Unemployed (2000)	Percent of Persons below Poverty (1999)
United States Average	$41,994	3.7	12.4
West Virginia	$29,696	4.0	17.9
Tucker County	$26,250	4.2	18.1
Elkins (Randolph County)	$26,906	4.7	14.4
Davis (Tucker County)	$25,221	5.2	14.6
Thomas (Tucker County)	$22,443	3.6	13.7
Parsons (Tucker County)	$26,424	4.3	18.7

Source: U.S. Census Bureau (2008)

Recreation and Tourism

The travel and tourism industry continues to be a significant and growing contributor to the West Virginia economy. According to a recent report on the economic impact of travel on West Virginia, travel-generated spending totaled over $3.97 billion, supporting 44,000 jobs with $854 million in earnings (Dean Runyan Associates, 2007). According to the report, travel spending in West Virginia increased by 8.8 percent per year from 2000 to 2006. In 2006, travel-generated earnings accounted for 12.4 percent of total earnings in Tucker County and 1.6 percent of total earnings in Randolph County while travel generated employment accounted for 19.1 percent of total employment in Tucker County and 3.4 percent of total employment in Randolph County (Dean Runyan Associates, 2007).

With many acres of public land, including the refuge, the Monongahela National Forest, and Blackwater Falls and Canaan Valley State parks, Tucker County and the greater Canaan Valley offer numerous outdoor recreation activities. Popular activities include hunting, camping, mountain biking, fishing, whitewater rafting, and canoeing. Winter recreation activities are another major attraction in Tucker County with Canaan Valley Resort State Park and Timberline Resort for downhill skiing, and White Grass Touring Center (White Grass) for cross-country skiing and snowshoeing. On average, the resorts receive between 150 and 200 inches of snowfall each year. (Tucker County Convention and Visitors Bureau, 2008).

USFWS

Visitor center

Details about the economic contributions associated with wildlife viewing, fishing, and hunting in West Virginia are provided below.

Wildlife Viewing
Abundant opportunities are available throughout West Virginia for formal wildlife education or recreational viewing. Wildlife viewing can include the activities of observing, identifying, and photographing. The 2006 National Survey of Fishing, Hunting, and Wildlife Associated Recreation (FHWAR) asks respondents about wildlife viewing around their homes and trips taken for the primary purpose of wildlife watching (USDOI et al. .2008). In 2006, there were a total of 743,000 wildlife watching participants (residents and nonresidents) in West Virginia with over 4 million days of participation away from home. Spending associated with wildlife watching in West Virginia totaled $241.6 million in 2006; of which 56 percent ($136.1 million) were trip-related expenditures and 44 percent ($105.5 million) were spent on equipment and other expenses (USDOI et al. 2007).

According to a Service report, on the national and State economic impacts of wildlife watching (USDOI et al. 2003), accounting for the multiplier effect, spending by resident and nonresident wildlife watchers in West Virginia in 2001 generated $252.5 million in output, $74.7 million in wages, 3,946 jobs, and $6.4 million in State sales tax revenue. This accounted for 0.5 percent of total employment and 0.4 percent of employment income in West Virginia (USDOI et al. 2003).

Hunting
The FHWAR indicates that hunting participation in the U.S. declined from 14.1 million in 1991 to 13 million in 2005 (USFWS 2007d). Data from the 1991, 1996, 2001, and 2006 FHWAR indicate that the declines were attributable to declines in both recruitment of new participants and retention of former participants. According to Curtis Taylor, chief of the Wildlife Resources Section of the West Virginia Division of Natural Resources (WVDNR), hunting numbers in West Virginia have stayed fairly consistent and are not following the declining national trend (Darst, 2008). Hunting on the refuge has stayed consistent as well with an average of 1,837 hunting permits issued annually.

In 2006, there were a total of 269,000 resident and non resident hunters in West Virginia. Residents of West Virginia accounted for 72 percent of total hunters and 86 percent of the 3.9 million days of hunting in West Virginia (USDOI et al. 2007).

According to USDOI and others (2007), hunting-related expenditures by State residents and nonresidents in West Virginia totaled $284.5 million in 2006; of which 28 percent ($79.4 million) were trip-related expenditures and 72 percent ($205.1 million) were spent on equipment and other hunting-related expenses (i.e., membership dues, licenses, permits and land leasing). According to a report by Southwick Associates (2007) accounting for the multiplier effect, spending by resident and nonresident hunters in West Virginia generated; $453.5 million in output, $133.2 million in income, 6,337 jobs, and $29.6 million in State and local sales taxes in 2006.

Fishing

The FHWAR indicates that fishing participation in the U.S. declined from 35.6 million in 1991 to 34.1 million in 2005 (USDOI et al. 2007). Similar to hunting, the FHWAR data indicate that the declines were attributable to declines in both recruitment of new participants and retention of former participants.

In 2006, more than 376,000 people in West Virginia participated in freshwater fishing. West Virginia residents accounted for 77 percent of total freshwater anglers and 94 percent of the 6.9 million days of freshwater fishing in West Virginia (USDOI et al. 2007). Direct spending in West Virginia by State resident and nonresident freshwater anglers totaled $334 million in 2006; of which 46 percent ($154 million) were trip-related expenditures and 54 percent ($180 million) were spent on equipment and other expenses (USDOI et al. 2007). According to a report by Southwick Associates (2007b) accounting for the multiplier effect, spending by resident and nonresident anglers in West Virginia generated $485.3 million in output, $137.9 million in income, 6,617 jobs, and $29.2 million in State and local sales taxes in 2006.

The Refuge and its Resources

This section presents an overview of land uses within the study area and emphasizes land use patterns of the watershed within the existing refuge acquisition boundary.

Land Acquisition History

Canaan Valley National Wildlife Refuge was first designated administratively by the Service in a decision document released on May 30, 1979. However, the Service decided to await the outcome of litigation surrounding a proposed storage hydroelectric facility before establishing the new refuge. The refuge was established on August 11, 1994 upon Service acquisition of the first tract of land. The refuge now consists of 16,193 acres. The Service has acquired lands for the Canaan Valley refuge under the following authorities:

1) Fish and Wildlife Act of 1956 [16 U.S.C. 742f(a)(4)]

2) Emergency Wetlands Resources Act of 1986 [16 U.S.C. 3901b]

3) Migratory Bird Conservation Act of 1926 [16 U.S.C. 715d]

Table 3.4 gives the land acquisition history of the refuge. See map 3-1 for the existing status of lands within the refuge's acquisition boundary.

We anticipate that the Service will continue to acquire lands within the approved acquisition boundary under the same authorities that have been used to acquire lands in the past. Based on refuge purposes, lands could also be acquired under several other legislative authorities, including but not limited to:

- Endangered Species Act [16 U.S.C. 1534]
- National Wildlife Refuge Administration Act [16 U.S.C. 668dd(b)]

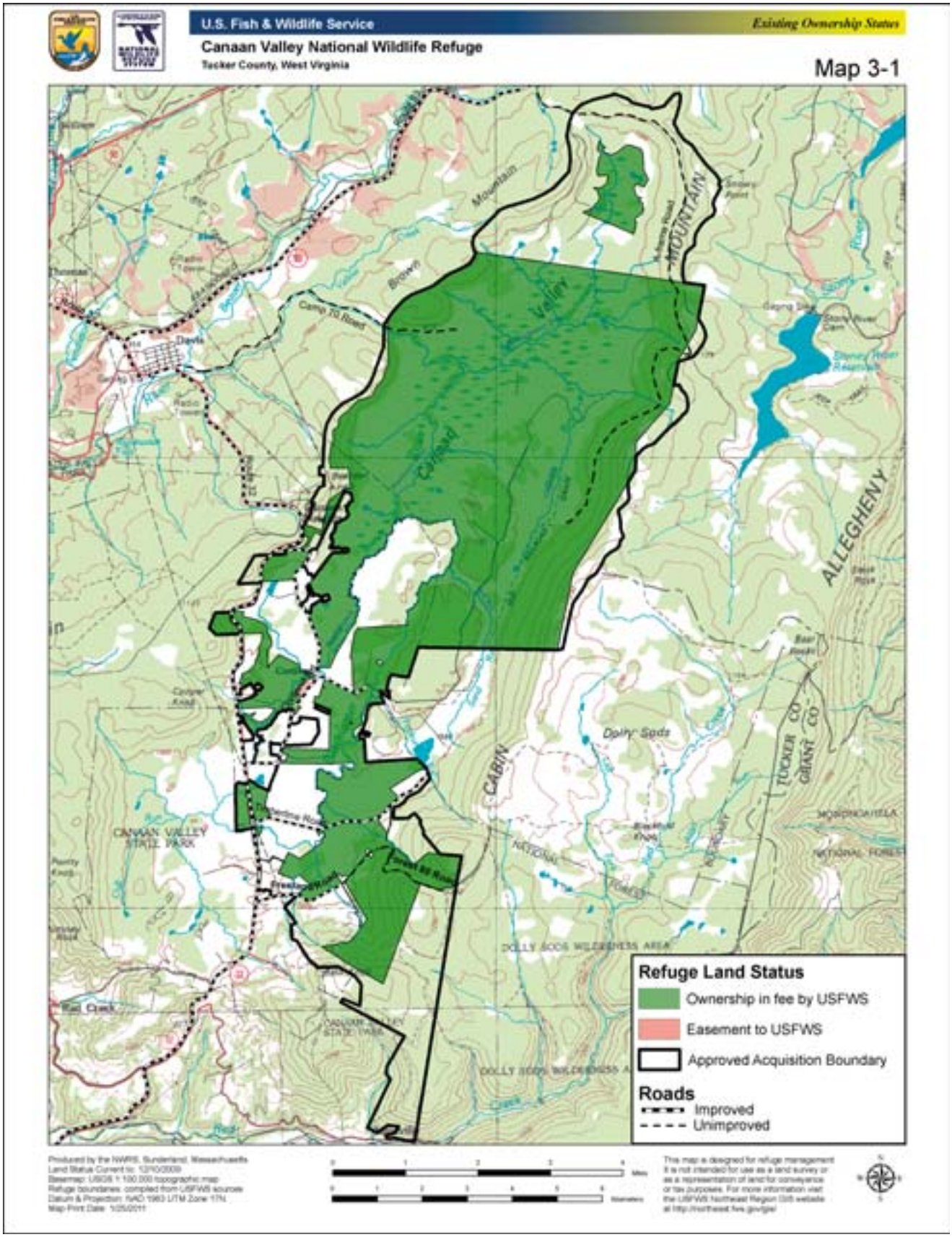

U.S. Fish & Wildlife Service
Existing Ownership Status
Canaan Valley National Wildlife Refuge
Tucker County, West Virginia
Map 3-1
Refuge Land Status
Ownership in fee by USFWS
Easement to USFWS
Approved Acquisition Boundary
Roads
Improved
Unimproved

Table 3.4. Land acquisition history for Canaan Valley refuge.

Calendar Year	Total Acreage	Location	Funding Source
1994	141.39	Tucker County	LWCF
1995	585.37	Tucker County	LWCF
1996	38.92	Tucker County	LWCF/Other
1997	59.66	Tucker County	LWCF
1998	922.28	Tucker County	LWCF
1999	1,501.46	Tucker County	LWCF
2000	43.35	Tucker County	LWCF
2001	10.37	Tucker County	LWCF
2002	11,961.43	Tucker & Grant County	LWCF
2004	560.90	Tucker County	LWCF/MBCF
2005	1.10	Tucker County	LWCF
2006	106.68	Tucker County	LWCF/MBCF/Other
2008	120.10	Tucker County	LWCF
2009	140.75	Tucker County	LWCF
Total	**16,193.76**		

Staffing and Budget

The current staff (2010) consists of eight permanent employees: a refuge manager, a deputy refuge manager, two wildlife biologists, two park rangers for Visitor Services, a park ranger for Law Enforcement, and an engineering equipment operator. In addition, there is a term position for an office assistant. Permanent staff, operations, and maintenance budgets over the last five years are included in Table 3.5. Operations funding includes those funds used for salaries, contracts, field projects, supplies, fuel, and utilities. Operations funding is split into account 1261 (wildlife and habitat management), 1263 (visitor services), and 1264 (refuge law enforcement) fund sources. Maintenance funding (1262) is used for maintaining the existing infrastructure, Youth Conservation Corps (YCC), and equipment replacement.

Significant maintenance projects completed over the last several years have included construction of a new maintenance building, headquarters parking area renovation, and repairs on Forest Road 80 and A-Frame Road. Additional funding was appropriated for construction of a residence building which was completed in 2006, new exhibits for the Visitor Center completed in 2006, and a native plant garden complete in 2007. The following costs have been incurred over the past four years.

Refuge Residence Building:	$250,000
Maintenance Building:	$742,600
Forest Road 80 and Headquarters parking area:	$118,000
A-Frame Road:	$360,000
Visitor Center exhibits:	$396,000

Table 3.5. Refuge budgets from 2002 to 2008

Year	Permanent Staff	1261 Funds	1262 Funds
2002	6	615,400	50,000
2003	6	729,425	92,250
2004	7	691,698	50,000
2005	8	751,169	68,600
2006*	7	756,390	90,455**
2007*	7	747,122	82,214**
2008*	7	831,713	76,150**

** The 1261 figure depicted here is the total of all 1260 (1261, 1262, 1263, and 1264) funding less 1262 maintenance, YCC, and vehicle replacement.*

*** Includes YCC and vehicle replacement.*

USFWS

Canaan Valley National Wildlife Refuge Friends group

Partnerships

Partnerships are vital to our success in managing all aspects of the refuge, from conserving land, to managing habitats and protecting species, to outreach and education, and providing wildlife-dependent recreation. The West Virginia Division of Natural Resrouces (WVDNR), the Natural Resources Conservation Service, the U.S. Forest Service (USFS), Canaan Valley Institute, West Virginia

University, Davis & Elkins College, West Virginia Highlands Conservancy, the West Virginia chapter of the Sierra Club, Trout Unlimited, The Conservation Fund, and The Nature Conservancy have been particularly important and valued partners.

Refuge Revenue Sharing Payments

The refuge contributes directly to the economy of Tucker County through annual revenue sharing payments. Since 1935, the Service has made Refuge Revenue Sharing payments to counties or towns containing lands under its administration. The Revenue Sharing Act (16 U.S.C. 715s) requires that the revenue sharing payments to counties for our purchased land will be based on the greatest of: (a) 3/4 of 1 percent of the market value; (b) 25 percent of the net receipts; or (c) 75 cents per acre. Land value for this calculation is re-assessed every five years. Since this refuge does not charge for entrance or services we have no net receipts. The exact amount of the annual payment depends on Congressional appropriations, which in recent years have tended to be less than the amount to fully fund the authorized level of payments. All of the alternatives will continue those payments in accordance with the law, commensurate with changes in the appraised market value of refuge lands, and new appropriation levels dictated by Congress.

Table 3.6 shows payments to Tucker County over the last eight years. The decrease in revenue sharing payments over the past several years is due to a decrease in national funding that is available for revenue sharing payments.

Table 3.6. Refuge revenue sharing payments for 2001 through 2007

Fiscal Year Paid	Acres	Value	Payment	Percent Payment
1994	Refuge Established			77.9
1995	86	$180,000	$1,041	77.1
1996	708	$3,390,000	$14,321	65.7
1997	747	$4,198,300	$22,816	72.5
1998	807	$4,974,300	$24,679	66.2
1999	1,553	$8,050,300	$37,588	62.2
2000	2,772	$13,146,800	$57,452	57.9
2001	3,281	$12,085,150	$46,086	50.9
2002	3,274	$12,085,150	$47,040	48.5
2003	15,235	$28,085,150	$102,122	46.6
2004	15,235	$28,085,150	$86,816	41.2
2005	15,796	$24,418,919	$85,247	46.5
2006	15,813	$24,608,919	$79,513	43.3
2007	15,834	$25,011,169	$78,143	41

Special Status Land

National Natural Landmark Designation
The Canaan Valley was designated as a National Natural Landmark (NNL) in 1974; twenty years prior to the establishment of the refuge. This designation established the northern 8 miles of the valley, approximately 15,400 acres, as a nationally significant natural area. Revision since the establishment of the landmark now includes a total of 24,763 acres of which 16,054 are refuge lands. The area contains a diverse assemblage of relict northern boreal communities and wetlands seldom found in the eastern United States. The valley is unique at this latitude with respect to size, elevation, and diversity. Canaan Valley contains approximately 8,400 acres of wetlands, which is the largest area of wetlands in West Virginia. The landmark status holds no legal obligations; however, the Service has a resource management responsibility for high quality habitat types, as recognized in the NNL program. As such, all alternatives will uphold the founding purposes for the establishment of the NNL and the refuge will work with the National Park Service (Park Service) to further the purposes of the NNL in keeping with the purposes of the refuge and the mission of the Service.

National Wild and Scenic River Designation
The Blackwater River is being studied as a potential river to be included as a National Wild and Scenic River (NWSR). The Blackwater River was studied under the National River Inventory through the Park Service and was determined to possess qualities that would make it suitable for designation. Particularly the scenic, fisheries and recreational qualities were found to be suitable for this designation. Designation of the river will be determined by the Park Service upon review of the river to ensure it meets all necessary criteria.

Vegetation and Habitat Resources

Upland Early Successional Habitat

Canaan Valley is a large, high elevation wetland surrounded by forested upland slopes that is well known for its unique assemblage of plants and habitats. See map 3-2 for existing refuge habitat types. The valley, which contains the headwaters of the Blackwater River, and extensive peatlands and shrub swamps, represents the diversity and abundance of State and regionally rare plants and plant communities found in surrounding smaller wetlands of the Allegheny Plateau highlands. Information is presented below on the important habitats and plant species (including exotic and invasive species) present on the refuge. This section ends with a discussion of regional trends for important habitats.

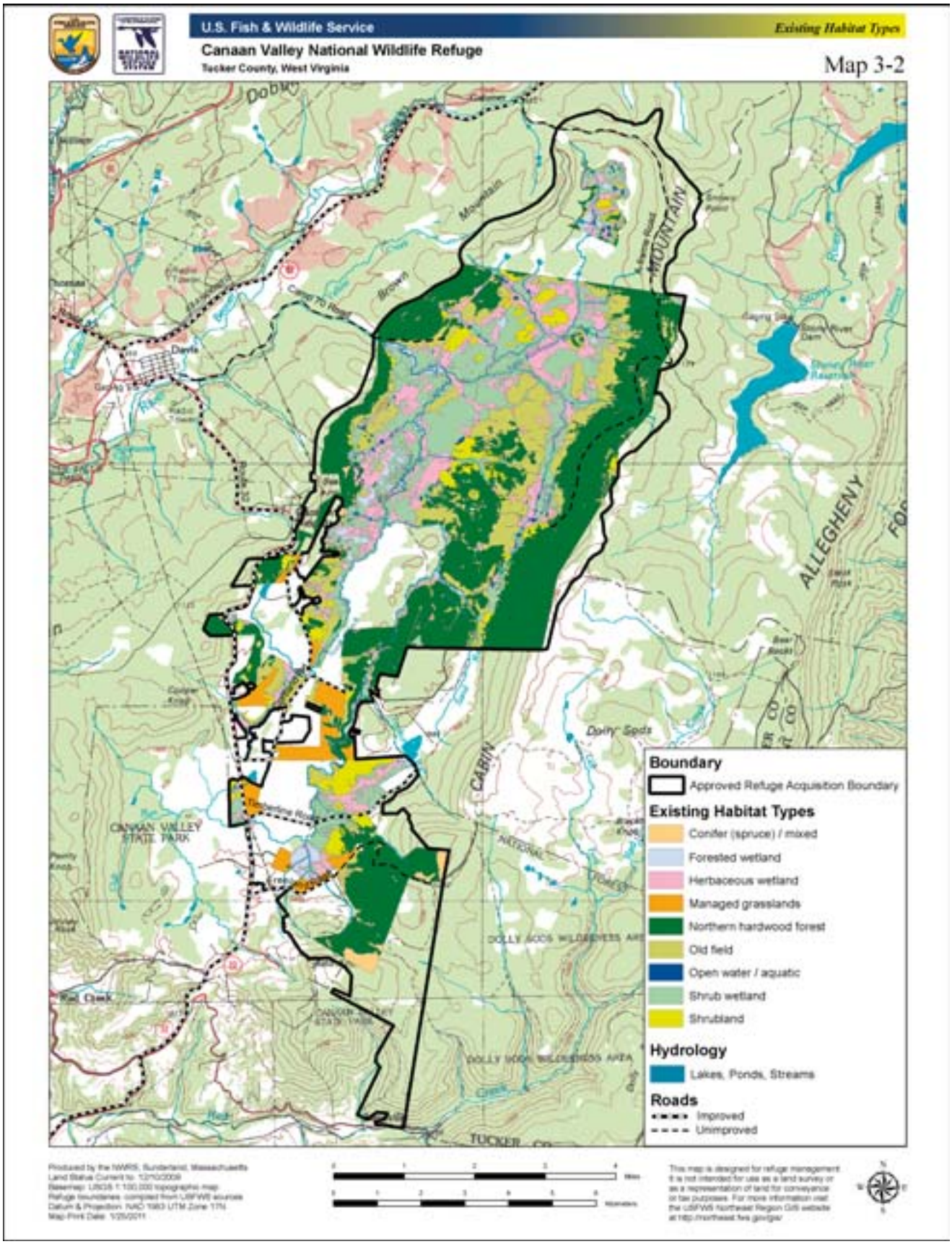
Habitats and Vegetation Communities

The early explorers to Canaan Valley colorfully reported entering a tangled mass of impenetrable spruce forest and rhododendron swamp. Historical descriptions of the area included statements of extensive laurel thickets, large dead trees covered in moss, and dense conifer forests. Other visitors more quantitatively wrote of an area which included Canaan Valley, "that nowhere else in the United States are now existing denser forests than those of black [red] spruce in the belt of country 100 miles in length and from 10 to 20 in breadth" (Rives 1898). Red spruce, eastern hemlock, and yellow birch were the principal canopy species, and rhododendron grew in dense "brakes of great extent." Mosses, lycopodiums, and occasionally wood sorrel and trilliums formed a sparse ground cover. Open glades, presumably of grasses, sedges, and forbs, followed the serpentine stream corridors on the valley's floor.

Ken Sturm/USFWS

Jacob's ladder

Severe ecological disturbances to the area's forests occurred in the late 1800s and early 1900s. Logging began in the Canaan Valley area around 1885, and continued until the 1920s (Carvell 2002). Following this clearcutting, lands in the valley were exposed to human-induced wildfires, some accidental, others


U.S. Fish & Wildlife Service
Existing Habitat Types
Canaan Valley National Wildlife Refuge
Tucker County, West Virginia
Map 3-2
Boundary
Approved Refuge Acquisition Boundary
Existing Habitat Types
Conifer (spruce) / mixed
Forested wetland
Herbaceous wetland
Managed grasslands
Northern hardwood forest
Old field
Open water / aquatic
Shrub wetland
Shrubland
Hydrology
Lakes, Ponds, Streams
Roads
Improved
Unimproved
CANAAN VALLEY STATE PARK
DOLLY SODS WILDERNESS AREA
ALLEGHENY
MOUNTAIN
CABIN
Dairy Spots
TUCKER CO.

for the purposes of clearing the land of slash and facilitating hunting and agriculture. These unregulated, uncontrolled, and unmanaged fires burned off topsoil and obliterated underlying seed sources, thus drastically altering the plant communities in the valley for decades to come. Erosion also removed the accumulated soils, therefore slowing the revegetation of the slopes and wetlands. Settlers converted the former forest land to pasture. In the mid-1900s, farmers converted some pasture to crops. Each of these land uses is represented within the refuge, and current community types reflect their history.

Canaan Valley lies within the Allegheny Mountain section of the Central Appalachian broadleaf forest-coniferous forest-meadow province (Bailey et al. 1994). Habitats on the refuge include freshwater wetland (34 percent, 5,407 acres), open water and riverine (1 percent, 166 acres), and upland (65 percent, 10,481 acres). We grouped all the habitats on the refuge into three broad habitat types: wetlands, upland early successional habitat, and upland forest. Within some of these broader habitats types we have tiered out finer habitat types. Under wetlands, we have shrub wetlands, herbaceous wetlands, and open water. Under early successional habitats we have shrubland, old field, and managed grasslands. Under upland forest we have northern hardwood forest and conifer (spruce)/ mixed forest. See Table 3.7 of the broad habitat types and their associated finer habitat types.

Table 3.7. Habitat types within the current refuge acquisition boundary.

Habitat Type	NVCS[1] Association	Acres owned by the refuge*	Acres not owned by the refuge
Freshwater Wetlands			
Forested Wetlands (conifer, deciduous)	Balsam fir–black ash swamp Balsam fir–oatgrass swamp Balsam fir–winterberry swamp Red spruce–yellow birch–mannagrass swamp Red spruce–hemlock–rhododendron swamp Quaking aspen swamp	412	102
Shrub Wetland (shrub swamp /mixed, speckled alder, spirea)	Blueberry–bracken fern shrub swamp Bushy St. John's-wort shrub swamp Chokeberry–wild raisin shrub peatland Meadowsweet shrub swamp Silky willow shrub swamp Speckled alder shrub swamp Speckled alder–arrowwood shrub swamp Steeplebush shrub swamp	3,187	658
Herbaceous Wetland (peatland, wet meadow, sedge meadow)	Cottongrass fen Silvery sedge fen Threeway sedge fen Nodding sedge fen–prickly bog sedge seep Star sedge fen Lake sedge fen Beaked sedge fen American bur-reed marsh Bluejoint grass wet meadow Woolgrass wet meadow Tussock sedge wet meadow Rice cutgrass marsh Softstem bulrush marsh Goldenrod wet meadow	1,905	288
Open Water/Aquatic (ponds, streams, river, other impoundments)	Water	166	43

Habitat Type	NVCS[1] Association	Acres owned by the refuge*	Acres not owned by the refuge
Upland Early Successional			
Shrubland (upland mixed shrub)	Meadowsweet shrubland* Bushy St. John's-wort shrubland* Spirea	859	470
Old field (upland old field/ meadow)	Goldenrod-sheep fescue/oat grass–bracken fern* Successional old field meadow* Hawthorn savannahs*	2,536	1,350
Managed Grasslands		512	6
Upland Forest			
Northern Hardwood Forest (Upland deciduous)	Central Appalachian northern hardwood forest Central Appalachian hemlock–northern hardwood forest Yellow birch / eastern rough sedge–marsh blue violet / wavy-leaf moss sloping forested seep Rough sedge seep Black cherry toe slope forest and woodland*	6,403	5,401
Conifer (spruce) / Mixed Forest (Upland conifer/mix)	Red spruce–yellow birch / mountain holly / bazzania / hypnum forest Red spruce–yellow birch–black cherry forest Red spruce / mountain laurel–menziesia rocky woodland	214	430
TOTAL		**16,194**	**8,748**

*NVCS*1-*National Vegetation Classification System*
**Provisional community names for types without NVCS matches.*

Freshwater Wetland Habitat

The wetland complex in the Canaan Valley represents the most significant wetland area in the State. An estimated 8,475 acres of wetland occur in the valley, of which the refuge currently protects 5,573 acres or 66 percent of all wetland habitats, including water, herbaceous, and woody wetlands, within the Canaan Valley watershed. According to previous work by the WVDNR, the wetlands of Canaan Valley represent almost 30 percent of the total wetland acreage in the State (Evans et al. 1982). The majority of the refuge wetlands occur in the Main Tract and Big Cove, draining the Little Blackwater River, Glade Run, Sand Run, and the Blackwater River. In the southern end of the refuge, the Herz, Cortland, Orders, Freeland, Cooper, and Reichle Tracts support wetland communities.

The wetland communities in Canaan Valley are diverse. A mosaic of shrub swamps, peatlands, and wet meadows provide habitat to a variety of passerines, shorebirds, waterfowl, amphibians, reptiles, and mammals, including alder flycatcher, northern harrier, swamp sparrow, southern bog lemming, Indiana bat, black ducks, American woodcock, snipe, American bittern, and Virginia rail. Recent dragonfly surveys have documented several rare species in West Virginia including the delta-spotted spiketail, comet darner, Hudsonian whiteface, ski-tailed emerald, and whiteface meadowhawk.

Similar to the upland habitats, the wetlands of Canaan Valley are reported to have been dominated by spruce forests prior to the late 1880s. Remnant stumps and roots visible in the peatlands and others uncovered in a soil study support these accounts. Rives (1898) reports open glades, presumably of grasses and forbs, in the valley bordering streams and rivers. Beaver activity may have kept glades open and successional habitat available.

Accompanying the logging activity was the building of railroad and road grades crossing the valley floor. These grades were elevated above the wetland by piling rock and debris into the wetland, creating impoundments and altering the hydrology of the valley. Many of these grades are still acting as impediments to water flow, and plant communities can vary significantly from one side of the impoundment to the other.

Prior to refuge acquisition of the Main Tract, use of the wetlands was open to the public and largely unregulated. A yearly event during the 1980s, the Blackwater 100 attracted thousands of spectators and all-terrain vehicles, motocross, "mud-buggy", and "bog-truck" riders for races and events in the wetlands. These activities removed vegetation, peat accumulation, and soil in the high-use areas. Vegetation is regrowing in some areas; other locations remain eroded and unvegetated. Some of the tracks or pathways have become channelized and act as barriers to surface water flow.

Beaver are active in Canaan Valley. Abandoned ponds succeed to vegetated habitat, and woodlands and shrublands in the wetlands near active ponds are used for foraging. This cycle of succession continuously, albeit slowly, alters wetland habitats in the valley.

The bottomland communities are shrub wetlands, herbaceous wetlands, and forested wetlands. The shrub wetland communities (alder, spirea, and other species) in the valley have been reported to be the fourth largest in the eastern United States, exceeded only by sites in Kentucky, Vermont, and Maine (Vogelmann 1978).

Shrub Wetland

Shrub wetland communities in Canaan Valley primarily include speckled alder swamps, spirea thickets, and mixed shrub swamps. Speckled alder is one of the dominant shrubs in Canaan Valley, covering approximately 14 percent of the refuge wetlands. Alder is valued for the habitat it provides to American woodcock and other species using early successional habitat. Alders in mature stands reach 3-4 meters in height, and approach 10 cm in diameter. The understory and ground cover of the alder stands appears to depend upon the hydrologic regime and soil and water acidity. In the circumneutral alder stands, a diversity of herbaceous plants can be found, including manna-grasses, arrowleaf tearthumb, and Jacob's ladder, a State species of concern. Accompanying the alder in the canopy are red spruce, yellow birch, balsam fir, and black ash. Balsam fir and black ash are considered rare in West Virginia. Nutrient-poor stands of alder may contain wild raisin, winterberry holly, and elderberry in the shrub layer. Sedges, bog goldenrod, sphagnum and haircap mosses occur as ground cover. Although abundant in Canaan Valley, the occurrence of rare species in these shrublands and the wetland character of the shrublands, classifies these habitats as rare (Fortney et al. 2005).

Typical alder swamps in Canaan are seasonally to semi-permanently inundated, holding standing water for most of the growing season. The stands border the major streams of the valley, including Glade Run, the Little Blackwater, the North Branch of the Blackwater, and the headwaters of the main stem of the Blackwater River.

In the 1970s, WVDNR biologists experimentally planted a stand of alder, in an area known as the potato field. Seed for the planting was collected from Canaan Valley and grown at a nursery in Parsons, Tucker County (Walt Lesser, personal communication). More recently, refuge staff experimented with cutting a ¾ acre patch of alder to observe the root sprouting potential for regenerating alder stands. Staff also collected alder seed from the refuge. The U.S. Department

of Agriculture's Plant Materials Center in Alderson is growing the seed, which refuge staff has begun to transplant onto the refuge to increase the succession rate of wet meadows into shrubland habitat more suitable for priority migratory bird species.

Meadowsweet spirea forms dense thickets covering over 452 acres of the refuge. Steeplebush spirea forms a rarer plant community type, of a few acres. These thickets are more frequent in the southern and western wetlands in the valley. Spirea may form pure stands or mix with willow and alder. Often impenetrable and growing to two meters, spirea stands have very little vegetation in the understory. Fortney suggests that the spirea stands have developed on poorly drained abandoned meadows, quadrupling in area since 1945 (Fortney 1997).

The largest wetland plant community is shrub swamp of a diversity of species, comprising nearly 1,943 acres, or 35 percent of the total wetland acreage of the refuge. The species of these shrublands are Glade St. Johnswort, chokeberry, wild raisin (a viburnum), arrowwood viburnum, blueberry and huckleberry, mountain laurel, and willow. The wetland surrounding the confluence of the Little Blackwater and the Blackwater Rivers is predominately mixed shrub swamp.

The wetland communities, chokeberry and blueberry, are considered a rare habitat type in the Allegheny Mountain ecoregion (Fortney et al. 2005). These communities may be mixed with the viburnums, and typically occur over peatlands or, in less saturated conditions, over dewberry and haircap moss. Glade St. John's wort is a low shrub that grows along streams and in adjacent poorly drained to saturated low fields. It may be found mixing with velvet-leaf blueberry, and with forbs such as bog goldenrod, grass-leaved goldenrod, and sedges. Willows typically grow in more nutrient-rich, saturated soils near flowing streams and seeps.

Herbaceous Wetland

Herbaceous wetland habitats in Canaan Valley include both peatlands and wet meadows and comprise 1,883 acres on the refuge. Peatlands are acidic fens receiving drainage and nutrients from surrounding mineral soils. Two general types of peatlands are recognized: those dominated by sphagnum and those dominated by haircap moss. Forbs (bog goldenrod, yellow bartonia), grasses and sedges (cottongrass, white beakrush), and dwarf shrubs (cranberries, creeping snowberry, blueberry, chokeberry) may also occur. The accumulation of mosses creates small mounds in a hummock and hollow micro-topography. The deep organic soils of the peatlands are seasonally to semi-permanently inundated. As a wetland community rarely occurring in the ecoregion outside of Canaan Valley, Fortney et al. (2005) classify peatlands as rare habitats.

The refuge supports 566 acres of peatland, 10 percent of the total refuge wetlands. The largest contiguous peatlands occur in the north-central wetland on the Main Tract between Glade Run and the Little Blackwater River, and adjacent to the west side of Middle Ridge north of the Blackwater River.

Wet meadows are low-level expanses of sedges, grasses, rushes, or forbs that are seasonally inundated. On the refuge, over 1,317 acres are characterized as wet meadow, making it the second most dominant wetland habitat type after shrub wetlands. Wet meadows are classified by their dominant species. Sedge, rush, and bulrush are the most common dominants. Several species are common in these communities: common rush, bluejoint grass, manna-grass, rice cutgrass, *Scirpus atrocintus, S. macrocarpon, S. atrovirens, Carex folliculata, C. stricta, C. scoparia, C. lurida,* and *C. vulpinoides*. Cattails, and a variety of other sedges, bulrushes, and rushes also occur. Common forbs are bog goldenrod, marsh St. John's wort, bugleweed, narrow-leaf gentian, and dewberry.

Wet meadows are interspersed between other community types, creating a mosaic of types. They most frequently border streams and drainages and are transition communities between the uplands and shrub wetlands. One of the largest contiguous wet meadows on the refuge can be found on the Herz Tract.

Bluejoint grass forms dense colonies, often excluding other species. These wet meadow community types are considered rare by Fortney et al. (2005) because of the rarity of wetlands in the Allegheny Mountain Section ecoregion and because several of the species occurring in the wet meadows are West Virginia species of special concern.

Forested Wetland

Forested wetland communities include deciduous and coniferous wetland forests, as well as a small amount of planted pine plantation. Together these communities make up 347 acres of refuge habitats. Deciduous wetland forests are of two types. Quaking aspen groves are found in the Bearden Flats and Glade Run wetland complexes, and mixed hardwood communities are found on riverside terraces of the Blackwater River and Sand Run. These hardwood forests are typically dominated by black cherry, yellow birch, and red maple. Hemlock, red spruce, and alder occasionally accompany this mix of species. In many ways this habitat resembles the upland deciduous forest—black cherry groves in overstory composition. The shrub layer and ground cover however, are typically more diverse and reflect the poorly drained to seasonally saturated soils.

Quaking aspen groves are colonies of even-aged, often mature, aspen, and are considered rare by Fortney et al. (2005). Spirea, manna-grasses, and goldenrods are typically found in the understory. Regeneration of these groves is not naturally occurring. Natural regeneration of aspen does seem to be occurring in the northeastern wetlands of Big Cove. Refuge staff is actively managing aspen stands to stimulate sapling growth to provide early successional habitat.

Compared to the reports from the late 1800s of the extensive red spruce forests throughout the valley, a small portion of the wetland is currently forested with red spruce, eastern hemlock, or balsam fir. Today 2 percent, or 132 acres, of the refuge wetlands are coniferous forest, and Fortney et al. (2005) list these habitat types as rare because of their current paucity within the Allegheny Mountain Section or because they contain rare plant species. These forests occur on low-lying sections of Freeland and Cooper Tracts, and along the major riparian corridors such as the Blackwater River through Middle Ridge.

Red spruce, balsam fir, and eastern hemlock are the dominant species in this forest type. Red maple, black ash, serviceberry, black cherry, yellow birch and mountain ash are co-dominants. During the past ten years, the population of balsam fir has declined due to an infestation of the balsam woolly adelgid. Additional mortality is caused when beaver flood low-lying stands of fir. The most extensive stand of balsam fir, on Freeland Tract, is less than half of its size ten years ago. Deer browsing eliminates many of the naturally regenerating balsam seedlings. In an effort to perpetuate balsam fir on the refuge, staff and volunteers plant balsam seedlings grown from Canaan Valley stock. Deer exclosures protect the seedlings from browsing.

Red pine-planted forests occur in two locations in Canaan Valley refuge. The first location is on the Main Tract adjacent to the Blackwater River upstream from the mouth of the Little Blackwater River. The second plantation is on Herz Tract adjacent to the Blackwater River downstream from the Old Timberline bridge crossing. The history of these plantings is unknown, and they do not appear in aerial photographs from 1968, indicating they are less than 40 years old.

Open Water/Aquatic Habitats

Two types of open water habitats occur in Canaan Valley. Riverine habitat totals approximately 72 acres and beaver ponds and other open water currently total 93 acres. Fluctuations of beaver pond habitat are natural and directly related to the abundance of beaver and available habitat on the refuge. The Blackwater River and its tributaries are often deep-channeled, serpentine, meandering streams of the valley floor. Impoundments are either natural (beaver ponds) or manmade (settling ponds). On the land currently managed by the refuge, the impoundments are active and abandoned beaver ponds. The acreage of beaver ponds fluctuates almost yearly with changes in beaver activity. Snapping turtles, mink, river otters, muskrat, and a variety of ducks, fish, marsh birds, and other mammals use these open water habitats.

The Blackwater River in Canaan Valley remains free-flowing. Sedimentation from logging and construction in the valley, unmaintained sewage treatment systems, and atmospheric pollution are the major sources of degradation to the water quality. The river is stocked with non-native brown and rainbow trout. Native brook trout spawn in several streams flowing into the Blackwater River.

Marquette Crockett/USFWS

Boardwalk, Canaan Valley National Wildlife Refuge

Most of the river channels in Canaan Valley are low gradient meanders through the valley's wetlands. In these areas the rivers and streams cut deep, soft bottom channels. In the low-lying areas, streams are buffered by wetland habitats such as wet meadows, alder and other shrub thickets, and forested wetlands. The river's main stem takes on another character as it divides Middle Ridge, widening and flowing over a rocky shallow bottom. Steeply sloped upland mixed and deciduous forests border the river in this stretch.

A multitude of active, abandoned, and relict beaver ponds provide open water and emergent habitat. Some beaver ponds visible on 1945 aerial photos are now wet meadows or shrub thickets while others still retain water. Because of these varying stages of activity and abandonment, the ponds provide a diversity of habitat, from shallow to deep, from still water to flowing, and a shifting set of plant communities adapted to these conditions.

As the beavers exploit woody vegetation for forage and construction, rare or important plant populations may be threatened. The refuge provides a limited number of special use permits to trap beaver in designated areas to prevent loss of important habitat types. Other communities, such as the rare Sparganium chlorocarpum marsh, are early successional in old beaver ponds and depend upon the beaver activity followed by abandonment to occur.

Upland habitat consists of lands not inundated by water except during catastrophic events. Upland habitats in Canaan Valley refuge include the early successional and upland forest habitats in Table 3.7: northern hardwood forest, conifer (spruce)/mixed forest, managed grasslands, old field, and shrubland. The

upland areas of the refuge border the wetlands to the west and east, and occur on a low sandstone ridge extending into the center of the valley from the south. The forests provide nesting habitat for forest-interior songbirds, more general forest songbirds (including brown creeper, black-billed cuckoo, veery, hermit thrush, and wood thrush), and ruffed grouse. White-tailed deer, black bear, fisher, northern watershrew, red-backed and mountain dusky salamanders, and a variety of other reptiles, amphibians, and mammals use the upland habitats of the refuge. The upland spruce forests provide specialized habitat for saw-whet owl, yellow-rumped warbler, blackburnian warbler, snowshoe hare, the West Virginia northern flying squirrel, and the threatened Cheat Mountain salamander. The grasslands near the valley floor host grassland bird species such as bobolink, Henslow's sparrow, grasshopper sparrow, eastern meadowlark, and savannah sparrow. Adjacent shrublands interspersed with grass-forb meadows host nesting field sparrows, chipping sparrows, and vesper sparrows.

Much of this upland is believed to have been part of the former expanse of red spruce forest. Early records describe the forest composition variously as also containing eastern hemlock, black cherry, and American beech. Spruce budworm or other infestations may have periodically killed swaths of the upland forests, making them more susceptible to lightning-strike fires or blow-downs from storms. Otherwise, large-scale disturbances prior to European settlement are expected to have been minimal.

Logging, initially for the red spruce and eastern hemlock, and in a second wave of more recent cutting for black cherry and other hardwoods, combined with agriculture and recreation uses has altered the composition and structure of these upland habitats. Following the logging of the early 1900s, the more gradual slopes of Cabin, Canaan, and Brown Mountains, and smaller ridges were cleared for pastureland and some later plowed for crops. These lower elevation "toe slopes" remain generally un-forested, as grasslands and shrublands.

Upland Early Successional Habitat

Managed Grassland

Refuge staff manages several former pastures as open grasslands, primarily for grassland bird breeding habitat. Prior to refuge acquisition, these fields were actively managed by the landowners as pasture and hayfields. These fields occur near the valley floor and on low broad ridges in the southern tracts of the refuge. Refuge fields are kept open by mowing, haying, or prescribed burning to slow the succession of forbs, woody shrubs, and trees into the fields. The dominant species of these fields are introduced cool-season grasses, including sweet vernal grass, orchard grass, velvet grass, and timothy. Reed canary grass is invading some of the fields and is controlled by herbicide spraying.

Old-Field

Similar to managed grasslands, old-field grasslands and grass-forb meadows are former pastures that have not reforested. However, these meadows were typically taken out of active management over 40 years ago, when they were purchased by the power company. The old-field community type is the second-most dominant type on the refuge, occupying approximately 15 percent of the refuge. These habitats occur on the lowest slopes and forest openings of Cabin and Brown Mountains, the northern and eastern perimeter of Middle Ridge, and along the eastern edge of the Blackwater River south of the confluence with the Little Blackwater River.

Poverty oat grass, deer tongue grass, bracken fern, hay-scented fern, wrinkle-leaf and grass-leaf goldenrod, and flat-top aster dominate these meadows. Dense patches of the introduced sheep fescue occur in the north-eastern fields

of the Main Tract. The meadows are broken by patches of Glade St. John's wort and blueberries. Hawthorns grow scattered throughout the meadows, creating a savannah-like appearance. The lack of woody regeneration in these fields—presumably former forest—after several decades of lying fallow, is notable.

Shrubland
In Canaan Valley, upland shrubland habitats occur on approximately 5.3 percent of the refuge lands. These shrublands occupy low slopes adjacent to wetlands transitioning to old-field grasslands or upland forests. The Herz tract supports the largest contiguous patch of upland shrubland on the refuge.

Shrubland habitats include pure or nearly pure stands of Glade St. John's wort, mountain holly, or hawthorn, or mixed shrublands that include velvet-leaf and upland low blueberries, arrowwood, and wild raisin. To provide singing grounds for breeding American woodcock, refuge staff mows approximately 30 acres of this habitat type on a rotational basis.

Ken Sturm/USFWS

Fall sunrise, Canaan Valley National Wildlife Refuge

Upland Forest

Northern Hardwood Forest
Upland deciduous forests, including northern hardwood forests, are the primary cover of the Allegheny Mountain Section ecoregion in West Virginia (67 percent; NRAC & WVCFWRU 2000). In Canaan Valley, northern hardwood forest is currently the predominant forest type occurring on over 6,403 acres. The northern hardwood forest community type also includes black cherry groves, upland aspen groves, and the unvegetated balds and ridges that occur within the forests.

Within northern hardwood forests, American beech, sugar maple, black cherry, and yellow birch are important canopy species. White ash, American basswood, hemlock, and red maple may also occur. Ground cover in some areas is dominated by hay-scented and New York ferns. In areas without these rhizomatous

ferns, lycopodiums, or spring ephemerals such as Jack-in-the-pulpit, trillium, Dutchman's breeches, wild leeks, and violets occur.

Prior landowners logged the northern hardwood forest beginning in the 1980s. Some tracts were logged as recently as 2001. Tables 3.8 and 3.9 list the volume and species of hardwoods removed during two of the most recent timber sales prior to refuge acquisition of the property (Scott Sidle, personal communication).

Table 3.8. Species and volume of hardwoods removed during 1998-2001 by Allegheny Power.

Species	Volume, International Scale (board feet)	% of Total
Sugar Maple	391,000	5
Red Maple	2,058,000	28
Black Cherry	3,980,000	55
Ash	45,000	0.5
Yellow and Black Birch	27,000	0.5
Beech	262,000	4
Aspen	483,000	7
Total	7,246,000	**100**

Table 3.9. Species and volume of hardwoods removed during 1995-1997 by Allegheny Power.

Species	Volume, International Scale (board feet)	% of Total
Black Cherry	9,297,000	63
Sugar Maple	1,473,000	10
Red Maple	982,000	7
Basswood	783,000	5
White Ash	1,340,000	9
Other	920,000	6
Total	14,795,000	**100**

Black cherry groves occur on 250 acres, typically on the low slopes near the valley floor. Black cherry *(Prunus serotina)* is the most important species in these groves, often occurring as pure stands. Red maple, serviceberry, quaking and big-tooth aspen may also occur, but infrequently. Club mosses, poverty oat grass, and blueberry are the dominant ground cover species. Upland quaking and big-tooth aspen groves account for approximately 6 acres of the northern hardwood forest community type. Goldenrods, bracken ferns, and oat grass compose the understory. As an early successional community, the aspen groves are being replaced by northern hardwoods. In order to regenerate aspen stands by root sprouting for early successional species such as woodcock, refuge staff has cut stands of upland quaking aspen. Fortney et al. (2005) consider both black cherry and quaking aspen groves rare community types because of their infrequent occurrence elsewhere in the Allegheny Mountain Section ecoregion (see below for an explanation of rare habitat types).

Upland balds occur on the high shoulder slopes of Cabin Mountain and continue outside of the refuge, to the east, ending at the eastern continental divide (Allegheny Front). These open grassy habitats and dwarf shrublands are dominated by mountain oat grass, wavy hairgrass, and upland low and lowbush

blueberries. Fortney et al. (2005) consider this habitat type rare, and expect the open, unforested condition to persist because of extreme temperatures and damage to vegetation by wind, ice, and snow.

Conifer (Spruce) / Mixed Forest
Conifer (Spruce)/mixed forest habitats in Canaan Valley include the hardwood/conifer mixed upland forests and conifer upland forests that occur on approximately 1.3 percent of Canaan Valley refuge. This percentage is similar to the 1.7 percent occurring within the Allegheny Mountain Section eco-region in West Virginia (NRAC & WVCFWRU 2000). Red spruce and coniferous habitats are believed to have been the dominant cover within the ecoregion prior to the logging of the early 1900s. Forest communities included in this type are Central Appalachian hemlock-northern hardwood forest, Central Appalachian spruce-northern hardwood mixed forest, red spruce forest, red spruce-yellow birch forests, and red spruce-hemlock-balsam fir forest.

The coniferous and mixed forests with a spruce component occur predominantly on the refuge's Kelly-Elkins tract near Cabin knob and Weiss knob on the slopes of Cabin Mountain. A spruce-hemlock-hardwood mixed forest occurs to the east of the Black Bear Woods housing development, adjacent to the wetlands of Bearden Flats. Spruce is regenerating in the understory of deciduous forests on the middle elevation slopes of Cabin Mountain, potentially converting these slopes to spruce-dominated forests over time. A small upland balsam fir forest occurs on the Cortland tract. Hemlock-northern hardwood forests typically border the high gradient headwater streams of Cabin and Brown Mountains. The refuge is actively working on red spruce ecosystem restoration through planting and experimental spruce release projects.

Rare Habitat Types

There are approximately 4,300 acres of rare habitat within Canaan Valley refuge, as defined by Fortney et al. (2005). The authors of this study defined rare plant communities as those having at least one of the following characteristics:

1) At least one dominant or co-dominant species with a limited distribution in the Allegheny Mountain Section of West Virginia.

2) The community in question must occur in a habitat type that is considered to have a limited or restricted distribution in the Allegheny Mountain Section (e.g. a wetland or grass bald).

3) The plant community type may be common, but it typically supports one or more rare plant species. Because of the overall limited area of wetlands in the un-glaciated Plateau, one the principal factors used to asses rarity was the occurrence in wetlands.

Forests are the dominant cover, over 80 percent in the Allegheny Mountain eco-region (NRAC & WVCFWRU 2000). Wetlands cover 4 percent. By Fortney's definitions, because wetland types are uncommon in the Allegheny Mountain Section of West Virginia, most of the wetland types in Canaan Valley are rare. Appendix A lists the rare plant communities on the refuge.

Plants, including Rare, Exotic and Invasive Species

Canaan Valley is recognized as having at least 583 plant species (Fortney 1975). A list of recently observed plant species on the refuge can be obtained by contacting the refuge. Forbs and creeping shrubs are the most abundant group of plants from this list, with 229 species. Graminoides (grasses, sedges, rushes, and their allies) are the next most abundant, with over 130 species. The number of species of ferns and fern allies is 35, and trees and shrubs is 89. Sedges (*Carex* sp.) are

the most abundant genus of plants, with 46 species. See Habitats and Vegetation Communities, above, for examples of plant species found in various habitat types.

There are no Federally listed threatened or endangered plant species on the refuge. The refuge, however, does provide habitat for many rare plant species that are tracked by the WVDNR Heritage Program and listed as critically imperiled, imperiled, or vulnerable. These plants are considered to be State species of concern. This designation does not provide Federal protection but indicates that the species is unique and/or rare enough to merit special consideration by WVDNR.

Botanists have recorded 73 State species of concern in Canaan Valley. Most of these species can be found in appendix A. The large size of Canaan Valley—10 times larger than other high elevation wetlands in the Allegheny Mountain Section ecoregion—supports a diversity of habitats rare in the region. Thus, while the valley is home to many State rare plants, few are considered rare throughout their entire growing range outside of West Virginia. However, twenty-eight species are listed as critically imperiled (S1) by the WVDNR Natural Heritage Program. NatureServe and the network of Natural Heritage programs rank four species (Appalachian blue violet, glade spurge, Appalachian oak fern, and Jacob's ladder) as globally vulnerable (G3), and none as globally imperiled (G1 or G2).

The cool, moist climate of the valley has maintained favorable growing conditions for northern plant species following the last glaciation. Balsam fir represents one of 109 plant species that have distinctly northern ranges but are able to persist in the valley. Twenty-three of these species and varieties have been reported from five or fewer locations in West Virginia (Hudgins and Scott 1988).

Exotic and invasive species are, so far, uncommon in Canaan Valley. An invasive cattail and yellow flag iris are becoming more abundant in nutrient-rich stream margins. Reed canary grass forms dense cover in poorly drained fields and substitutes poor-quality habitat for breeding grassland birds. For five years, refuge staff has controlled reed canary grass in an important grassland bird field by mowing and spraying.

Multiflora rose, autumn olive, barberry, and exotic pasture grasses are relicts of the agricultural and homestead use of the area. None are widespread, though multiflora rose is abundant in localized patches. Purple loosestrife, garlic mustard, Japanese stilt grass and Japanese knotweed grow nearby the refuge. Staff has hand-pulled garlic mustard yearly since 2005 and has sprayed multiflora rose with herbicide yearly since 2004 to control their spread in the area.

Fisheries Habitats and Resources

A total of 30 species of fish occur in the rivers, streams, and beaver ponds of the refuge and the Blackwater River drainage (Cincotta et al. 2002). Of these, 20 are native species and 10 are introduced non-native species. Historically it is likely that fish diversity in the Blackwater River headwaters area of Canaan Valley was limited due to the interruption and habitat barrier of Blackwater Falls, approximately 6 miles downstream from the refuge. These falls present a 65 foot vertical impasse which prevents migration of fish upstream into the Canaan Valley watershed. Fisheries resources were impacted greatly in the early 1900s as a result of timber removal and acid mine drainage. Fish species known or thought to occur in Canaan Valley are listed in appendix A. A list of the refuge's known and expected vertebrate species can be obtained by contacting the refuge or on the refuge website online at *http://www.fws.gov/canaanvalley/CVNWR-vertebrates.html*.

Four fish species once found in the Blackwater River drainage are now considered extirpated. These include the blackside dace, fantail darter, northern hogsucker, and river chub. These four species were considered native but possibly introduced to the Blackwater watershed. No recent surveys have documented these species on the refuge (Cincotta et al. 2002).

It is thought that many of the fish present in the valley occur as a result of either accidental angler releases or WVDNR introduced game species. Historical records indicate that brook trout were abundant in the Blackwater River before logging occurred. However, as railroads were extended into the valley, fires and sedimentation reduced water quality. As a result, brook trout disappeared from the main stem of the Blackwater River (Zurbuch, 2002). Other species thought to occur historically in the Blackwater include creek chub, bluntnose minnow, white sucker, stoneroller, Johnny darter, greenside darter, mottled sculpin and redside dace (Zurbuch 2002).

The first recorded fish stocking of the Blackwater River occurred in 1909 near Davis and consisted entirely of rainbow trout. Brook trout were also stocked near this location in 1910. By 1925 the WVDNR recorded stocking 30,000 brook trout in the Blackwater River and its tributaries (Zurbuch 2002). Stocking currently occurs at two locations on the south end of the refuge by the WVDNR (Blackwater River on Route 32 and Blackwater River on Timberline Road). Fish currently stocked in the Blackwater River are primarily brown trout and rainbow trout.

The WVDNR stocked largemouth bass in beaver ponds in the valley in at least 1963 and 1964 (WVDNR 1964). Since the refuge has been established, no bass stocking on refuge property has occurred.

About 20 large ponds currently exist but their capacity to support fish habitat is unknown. No inventory has been conducted to determine what existing beaver ponds still contain fish. Reports from anglers indicate that rock bass and largemouth bass are caught in beaver ponds receiving water from Glade Run on the east side of the refuge and the Blackwater River on the west side. Sunfish species such as bluegill and pumpkinseed are also reported from these ponds.

Brook trout are the only native salmonid to the Blackwater River. Naturally reproducing brook trout populations exist in several small cold streams that flow into the Blackwater River. Although no refuge-wide survey has been accomplished, populations of brook trout are known from Idleman's Run, Freeland Run and Yokum Run. There are historical documentations in the Little Blackwater River, North Branch, Flag Run and two other small tributaries in the valley. Additionally, some limestone springs have been noted with brook trout on the south end of the refuge.

A survey of Freeland Run in 2001 by WVDNR found 18 brook trout and 17 brown trout in a 250 foot section of the stream. Both species were found primarily as young of the year fish and indicating successful spawning and recruitment of both species. Brown trout likely inhibit habitat expansion by the native brook trout and are present in high concentrations in areas such as Freeland Run. A survey of Idleman's Run in 2008 by WVDNR found over 60 brook trout in a 350 foot section of stream. However, these trout were separated into three disjunct areas of the stream due to low water flows, partially caused by an upstream water diversion.

Redside dace, a rare medium sized minnow has also been found on the refuge. This species is listed as a State species of concern (S1S2) and is known from only 9 localities in West Virginia (Stauffer et al. 1995). Historic records document this species occurring in Freeland Run, Sand Run and the North Branch. Records of

this species in the 1940's and 1950's were apparently common in Canaan Valley occurring in small tributaries as well as the main stem of the Blackwater River (Cincotta et al. 2002). However surveys by the WVDNR in recent years have found this species only in Freeland Run and only one individual was found. It is possible that habitat alteration from development and other land use practices have degraded stream conditions precluding redside dace.

Wildlife

The refuge supports a diversity of wildlife in forest, meadow, riparian and wetland habitats. A total of 286 species of fishes, amphibians, reptiles, mammals and birds are known or expected to occur in the Canaan Valley. Much of the wildlife is typical of the West Virginia-Pennsylvania highlands border region. Commonly observed species include white-tailed deer, raccoon, black bear and Canada goose. However, the high elevation and large amount of wetlands provide habitat for some species more typical of northern latitudes such as the fisher, saw whet owl and Wilson's snipe. The land is managed and protected to maintain biological diversity and to protect and benefit threatened and endangered species and resident and migratory birds. There have been wildlife studies in the Canaan Valley prior to acquisitions by the Service but most are currently unavailable. A list of the refuge's known and expected vertebrate species can be obtained by contacting the refuge or on the refuge website online at *http://www.fws.gov/canaanvalley/CVNWR-vertebrates.html*.

Waterfowl

Although limited, the refuge provides an important contiguous wetland habitat for breeding and migratory waterfowl in West Virginia. Migratory birds are seen moving through the area in March-April and August-October. Common migratory waterfowl include divers such as lesser scaup, ring-necked duck, bufflehead, hooded merganser and dabblers such as green-winged teal and blue-winged teal.

The refuge has small numbers of breeding waterfowl including American black ducks, mallards, wood ducks, and Canada geese. Studies conducted from 1980 through 1993 found Canada geese, mallards, wood ducks, and black ducks to be the most abundant waterfowl in Canaan Valley (Michael and Brown 2002). Of the species present on the refuge, black ducks are the only species of management concern. Listed by the WVDNR as a species of special concern (S2B: very rare or imperiled) black ducks breed in secluded beaver ponds, oxbows, and wetland areas, mostly in the northern portion of the refuge. Black ducks are also a Service species of management concern covered by the North American Waterfowl Management Plan (NAWMP) (ACJV1988) with population and management objectives.

Canada geese were brought into the valley by the WVDNR beginning in 1967. Between 1967 and 1971 a total of 65 geese were released in Canaan Valley (Michael et. al. 1994). The program began through a transplant program to encourage a local nesting population in the valley. Since that time, Canada geese have been successful in nesting throughout the valley with flocks numbering over 300 birds. The geese are the only migratory flock in West Virginia, arriving in Canaan Valley in the early spring and departing in November. At least some of the geese have been reported wintering near Durham, North Carolina (Michael 1994).

The development of Timberline Resort, a residential community, and the Canaan Valley Resort State Park golf course increased the available browse habitat which has increased numbers of geese using the area. These developments may have allowed goose numbers to increase since the 1980's. Goose abundance increased to a level causing Timberline residential community to initiate an active hazing program to prevent goose use of the open water and grassland habitats within the development.

Waterbirds and Shorebirds

Waterbirds commonly observed on the refuge include great blue heron, green heron, and American bittern. Great Blue and green herons were found to be the most abundant waterbirds during surveys conducted from 1980 to 1993 (Michael and Brown 2002). All but the great blue heron have been documented as breeding birds on the refuge. In fact, the valley is the largest single breeding location in the State for American bitterns (Mitchell 2006).

Rails are occasionally heard on the refuge. Breeding records exist only for Virginia rail which has been documented in the upper Glade Run marshes and in isolated cattail stands throughout the refuge. During migration, sora rails are seen in some wetland areas around beaver ponds. King rails *(Rallus elegans)* may also migrate through the valley; however, no recent records exist for this species on the refuge.

Ken Sturm/USFWS

Wilson's snipe

Only five shorebirds are regularly seen on the refuge: greater yellowlegs, spotted sandpiper, solitary sandpiper, American woodcock, and Wilson's snipe. Of these the woodcock and snipe are common and breed on the refuge. Spotted sandpipers are found during summer months and likely breed along streams and beaver ponds on the refuge. Greater yellowlegs and solitary sandpipers use the refuge during migration in low numbers.

The refuge serves as one of West Virginia's largest concentration of woodcock and Wilson's snipe. The valley has been noted for a large woodcock migration in the fall. Although dated, WVDNR reports that the fall population of woodcock likely exceeds 2,200 individuals. Resident numbers of woodcock have been estimated at 450 individuals.

Breeding woodcock surveys have been conducted at the south end of the refuge since 1999. Average number of "peenting" males on the refuge has been 3.32 per route which exceeds the long-term State average of 0.52 males per route. Although refuge routes are not chosen randomly and therefore can not be directly related to standardized singing ground survey route data, the high response rate on refuge routes likely indicates that the refuge is still important for breeding woodcock in the State and region.

Woodcock habitat loss in the northeast is largely attributed to successional changes in forest and open land and loss of agricultural land through urban development. This holds true for Canaan Valley where open land has been developed in recent years, grazing has decreased and early successional forest cover has matured. Nonetheless, recent research found that the Canaan Valley still contained the largest amount of quality habitat in the State (Steketee 2000). The refuge conducts habitat management for woodcock including maintaining singing ground habitat and improving early successional aspen and alder cover for foraging and breeding habitat.

Wilson's snipe breed on the refuge and it is one of the southern most breeding sites for this species in the East. Snipe have a limited distribution in the State and have been documented as breeders in only three locations including Canaan Valley (Buckelew and Hall 1994). Although no large scale snipe surveys have been conducted on the refuge, coincidental surveys of woodcock have documented snipe breeding activity. Snipe are typically found throughout the northern portion of the refuge during summer months in wetlands and around beaver ponds. Nesting

snipe have been also documented in the refuges grassland management fields on the southern part of the refuge.

Landbirds

At least 181 bird species have been recorded in Canaan Valley (Northheimer 2002). Migratory birds pass through the valley and have been well documented by long term banding and monitoring along the Allegheny Front. Refuge landbird point counts have documented a total of 104 species breeding on the refuge. Almost one third of all species documented during landbird point counts are in the sparrow family.

The refuge lies within Bird Conservation Region (BCR) 28; the Appalachian Mountain Region, Physiographic Area 12. There are at least 25 species listed within Physiographic Area 12 that occur or nest on the refuge. Of these at least 16 regularly breed on the refuge including golden-winged warbler, Canada warbler, Henslow's sparrow and scarlet tanager. Two of these species (Henslow's sparrow and golden-winged warbler) are also on the American Bird Conservancy "Green List" of species with the highest continental conservation concern.

Raptors
A total of 15 raptor species have been documented on the refuge. Common *Buteo* raptor species on the refuge include red-tailed hawk, broad-winged hawk, and red-shouldered hawk. Both red-shouldered and broad-winged hawks are known to nest in the valley. Rough-legged hawks winter in Canaan Valley hunting over maintained grasslands in the southern end of the valley. Rough-legged hawks are typically the most abundant Buteo on the refuge during winter, although Christmas Bird Counts have documented occurrences of most others in the surrounding area.

Northern harriers, a State species of concern, are a regular migrant during spring and fall to the refuge. Records of harriers in June and July in the northern portions of the refuge are fairly common; however, no breeding activity has been documented and no known breeding records exist for northern harriers in the State (Buckelew and Hall 1994). Harriers hunt over the expansive wetland habitats in the northern portion of the refuge as well as grassland and wet meadows in the southern portion.

Both turkey vultures and black vultures occur on the refuge. Turkey vultures are common and have been documented breeding on both Brown Mountain and Cabin Mountain in recent years. Black vultures mainly occur in the Blackwater Canyon area and are only occasionally seen in the Canaan Valley.

American kestrels occur regularly in the valley, particularly in the southern end associated with open grassland habitat. Merlin are occasionally observed on refuge lands. Peregrine falcons have been seen in the valley but are considered to be accidental. Both Cooper's hawk and sharp-shinned hawk are relatively common and breed on the refuge. Northern goshawk, a State species of concern, was documented nesting near Sand Run in 1975. Although no recent nesting records exist for this species in the valley, a nest was confirmed on Canaan Mountain in 2006. Recent observations of juvenile goshawks in the Freeland Run area and Beall Tract have indicated that some refuge habitats are being continually used by this rare northern species. Bald eagles regularly use the area during winter months and golden eagles are occasionally seen on the refuge.

Nonpasserines
Species in this group are limited to only a few species and include hairy woodpecker, downy woodpecker, yellow-shafted flicker, yellow-bellied sapsucker, pileated woodpecker, belted kingfisher, and ruby-throated humming bird. All but

the yellow-bellied sapsucker (a BCR species of concern) are known to nest on the refuge.

Non-passerine species are mostly tied to wooded environments for foraging and nesting. All but the ruby-throated hummingbird are cavity nesters. Only the belted kingfisher is a wetland species, and it is often found hunting along the Blackwater River or one of its many tributaries. Yellow-shafted flickers are most common during migration when they are often seen foraging in grasslands, woodlots, and edge habitats.

Passerines
There are 88 species of passerines known to occur on the refuge, out of which at least 69 have nested. Many of these species are migratory; however Christmas Bird Counts have documented at least 35 passerines on the refuge or within the count circle. The refuge lies adjacent to a major fall land bird migratory route over the Allegheny Front: it serves as the eastern continental divide. The oldest continuously operated banding station occurs along the Allegheny Front which was established by George Hall and the Brooks Bird Club in 1957.

The refuge's diversity of habitats allows a wide variety of species to occur. Unique habitats include wetland (open water, palustrine, shrub and forested) and high elevation spruce and mixed spruce-hardwood forests. Refuge breeding landbird surveys were established to develop a comprehensive list of breeding birds across representative habitat types. Since one of the refuge's unique qualities is the extent of wetland habitat, many sampling points fall in and adjacent to wetland habitat.

Based on results from breeding bird surveys from 1996 to 2008, the species with the highest relative abundance is the common yellowthroat which comprised approximately 8 percent of all landbirds recorded. Red-winged blackbird, red-eyed vireo, savannah sparrow, field sparrow, and song sparrow all make up a significant portion of the total species abundance on the refuge.

Land Mammals

The refuge provides habitat for an estimated 50 species of mammals. Most are considered year-round residents with the exception of migratory bats. The most conspicuous mammal is the white-tailed deer which has reached high densities in the southern portion of the valley including the refuge. Deer browse pressure is heavy in the south end of the valley and likely a limiting factor to the regeneration of several plant species, most notably balsam fir.

Wetland areas support populations of beaver, muskrat, and mink. River otter are also found in small stream reaches such as Glade Run but are considered rare on the refuge. Research conducted by Francl (2003) on the refuge found nine species of small mammals in refuge wetland habitats. Two species documented, the southern bog lemming and meadow jumping mouse are State species of concern and tracked by the Natural Heritage Program. Except for the southern bog lemming, other species documented in this study are considered habitat generalists which may reflect the small size of wetlands studied rather than depicting true small mammal wetland communities on the refuge (Francl 2003). Another State species of concern, the eastern small-footed bat, was documented along the Blackwater River in 2006 by refuge staff using acoustical survey equipment.

Upland areas support species such as long-tailed weasel, bobcat, striped skunk, red fox, grey fox, and black bear. The refuge supports small populations of mammals more typical of northern climates such as fisher and snowshoe hare. Species of concern include the southern water shrew, southern pygmy shrew, long-

tailed shrew, meadow jumping mouse, Appalachian cottontail rabbit, southern rock vole and the Allegheny woodrat. The Allegheny woodrat has a confirmed record in Canaan Valley, but habitat for this species is considered limited on the refuge. Historical records indicate that the Appalachian cottontail rabbit has been documented in and around Canaan Valley, although no confirmed records exist for the refuge.

The West Virginia northern flying squirrel has been successfully trapped and monitored at one location on the refuge but is expected to range throughout the higher elevations of the Kelly-Elkins Tract. Nest box surveys have found nest material consistent with northern flying squirrel occupation in drainages from 3,500 feet up to 4,200 feet on Cabin Mountain. One pregnant female was documented in a nest box in mixed spruce-hardwood forest adjacent to an old road bed in 2003. As an endangered species the West Virginia northern flying squirrel was identified as a high priority in the State Wildlife Action Plan (WVDNR 2006). The species was also used as an indicator of quality spruce and mixed spruce-northern hardwood forest habitat by the USFS in their recent Forest Plan (USFS 2006a). Since the squirrel was de-listed the Service is still committed to monitoring refuge populations. The species is still considered a good indicator of quality spruce and mixed-spruce hardwood forests and therefore remains as a focal species for habitat management. The Service developed a Red Spruce-Northern Hardwood Ecosystem MOU with multiple Federal, State, and NGO partners. The vision of the MOU includes specifically to "…provide functional habitat to sustain the viability of the West Virginia northern flying squirrel…" (USFWS 2007b). As an active partner in the MOU, the refuge will still consider the West Virginia northern flying squirrel a focal species.

Reptiles and Amphibians

Ten species of reptiles and 18 species of amphibians are known or likely to occur on refuge lands. The most notable of these is the Federally threatened Cheat Mountain salamander which occurs in high elevation spruce and hardwood forests.

Ken Sturm/USFWS

American toad

Wetland areas provide habitat for pool breeding amphibians such as wood frogs, spotted salamanders, and American toads. Many pool breeding sites on the refuge are artificially created impoundments or historical ruts in logging roads or rail grades. Two species of frog reported in Canaan Valley but without recent documentation are American bullfrogs and leopard frogs (Pauley 2002). The most ubiquitous species of frog is the northern spring peeper which is found throughout the valley in all wetland habitat types. Wetland habitats with moss cover often provide habitat for four-toed salamanders, however this species uses hardwood forests during the remainder of the year.

Upland habitats such as high elevation spruce forests, mid and low-slope northern hardwood forests and old field areas provide habitat for most salamander species. Lungless salamanders (Plethodontidae) are the dominant amphibians in the refuge's forested habitats. Cheat mountain salamanders are found in small pockets of high elevation mixed spruce forest, but red-backed salamanders are the most common species in refuge forests. Large salamander species in woodland habitats include Wehrle's salamander and northern slimy salamander.

Reptile species are poorly documented in Canaan Valley. Only one study indicates an effort to inventory reptile species (Michael 1993) and no reptiles were reported from his field investigations. Refuge staff observations have confirmed the presence of 9 snakes, with two other species likely to occur. The timber

rattlesnake may occur in higher elevations of the refuge but no observations have been made to document its presence within the Canaan Valley watershed.

Two turtles have been confirmed on the refuge. The common snapping turtle is apparently the most abundant species and is found throughout the refuge, mostly associated with beaver ponds and oxbows. The eastern box turtle was originally not known from Canaan Valley, but observations of two individuals (a male and female) in 2005 and 2006 document its presence in the area.

Invertebrates

Only a few studies have been conducted on invertebrates on the refuge. Two inventories were conducted by Butler (1981, 1987) on Freeland Run for aquatic invertebrates. The inventory was conducted as part of an evaluation of a nearby sewage treatment facility. Butler noted a combined total of 22 species representing 25 families of invertebrates (Butler 1988). Additionally it was noted that over the sampling period, numbers of aquatic invertebrates were reduced indicating that Freeland Run had been altered reducing its ability to support a full diversity of aquatic life (Butler 1987).

A study of carabid beetles was conducted on the refuge in 1999 by the USFS. A total of 98 species were collected during the study. Of this, 23 were new records for the State (Davidson and Acciavatti 1999). This study documented 25 percent of the recorded State invertebrate records occurring in Canaan Valley. Freeland Tract had the greatest diversity of carabid beetles as well as harboring 10 new State records. These were species with more northern distributions and their discovery on the Freeland Tract extended their known range distribution further south in the eastern United States.

The refuge began a dragonfly and damselfly inventory during the 2005 field season. To date a total of 14 species of damselfly and 33 species of dragonfly have been collected from refuge tracts. While none of the odonate species collected on the refuge are globally rare, at least 13 of the species are listed as State species of concern. The diversity of odonates found on the refuge is remarkable and is an indicator of wetland health and quality.

There are several invasive pest invertebrate species on the refuge. Balsam wooly adelgid has infected most stands of balsam fir on the refuge and surrounding areas. This aphid species has been known in Canaan Valley since at least 1993. Most trees affected by the adelgid succumb within a few years. Additionally, hemlock wooly adelgid has been found at the State Park where it has killed many trees in a drainage area adjacent to the ski lodge. This species of adelgid poses a significant threat to riparian and forested wetland areas on the refuge.

One mussel species, the creeper *(Strophitus undulates)*, has been found on the refuge. This species was documented in 2000 in the Blackwater River on the Beall Tract. Habitat for mussels may be limited to the areas of the river flowing through Middle Ridge where river substrate may be more suitable. No surveys have been conducted for the distribution of this species on the refuge or within the Blackwater River drainage. Fingernail clam, a freshwater clam species, has been found in Freeland beaver pond and several surrounding streams on the refuge.

Butterflies and moths have been sporadically surveyed on the refuge and efforts are ongoing to further document these species. Monarchs and various swallowtail and fritillary species are commonly seen. At least three State species of concern, the Atlantis fritillary, the pink-edged sulphur and Harris's checkerspot have been documented on the refuge.

A survey of land mollusks on the refuge began in 2007 as a part of a statewide atlas project. While species collection and identification is still ongoing, 82 species of land snails have been documented from the refuge, including one species, *Ventridens arcellus,* which had not been collected from Tucker County in over thirty years and is a classic high elevation species often associated with limestone outcroppings. While the State rank of *V. arcellus* is currently under review, it is probable that the species will be included on the State species of concern list as an S1 or S2 species. Two snail species found on the refuge have been identified as potentially new to science (Dourson 2009). Two slugs, one native and one introduced, and at least two species of aquatic snails have also been documented from the refuge during this survey. Land snail abundance and diversity can be used as an indicator of forest and soil health.

Invasive and Exotic Wildlife Species

European starlings occur most commonly at the south end of the refuge in grassland and small woodlot habitats. As aggressive cavity nesters, they undoubtedly compete with native species such as eastern bluebirds, house wrens and tree swallows for available nest sites. Several non-native species of fish have been introduced into the Blackwater River and tributaries. Many of these introductions have occurred as a result of angler bait releases. As mentioned before, both balsam and hemlock wooly adelgid have been documented on the refuge.

Federally Endangered and Threatened Species

The refuge provides habitat for one threatened and one endangered species. The threatened Cheat Mountain salamander and the endangered Indiana bat have both been documented on the refuge. The West Virginia northern flying squirrel which occurs in refuge forests was de-listed as an endangered species in September 2008. The bald eagle, delisted in August 2007, uses the refuge during migration. Both the West Virginia northern flying squirrel and the bald eagle, although delisted, remain priority species for Service protection and management.

USFWS

Bald eagles

Both the Cheat Mountain salamander and West Virginia northern flying squirrel have only been documented on Cabin Mountain in the south eastern portion of the refuge. Both species require high elevation mixed spruce and hardwood forests. Cheat mountain salamanders occur in

patchy distributions above 3,800 feet and are likely limited by alterations in forest cover through historical unmanaged fires and logging activities. The smallest population of the salamander occurs on Cabin Knob with a known occupied habitat of only 0.5 acres. The largest known site on the refuge occupies at least 20 acres closer to Bald Knob.

In 1967, the Federal Government listed the Indiana bat *(Myotis sodalis)* as endangered because of declines in their numbers documented at their seven major hibernacula in the Midwest (USFWS 2007a). At the time of their listing, Indiana bats numbered around 883,300. Surveys in 2007 numbered the Indian bat population at 513,000 bats which in a 9.4 percent increase over the 2005 estimate and is also the highest estimate reported since systematic surveys began in the early 1980s. The 2007 range-wide population increase is attributed to significant population increases in Indiana, New York, Kentucky, and West Virginia (data is available from the Service at *http://www.fws.gov/midwest/Endangered/mammals/inba/*). More recent range-wide population estimates are not currently available. However, the emergence of White Nose Syndrome in 2007 and associated mortality in subsequent years has likely reduced populations of these bats in affected areas, including New York, Vermont, New Hampshire and Pennsylvania. With the discovery of White Nose Syndrome in Virginia and West Virginia in 2009, further mortality is likely to occur.

Indiana bats were documented on the refuge for the first time through acoustical monitoring conducted by the USFS in 2003 (Ford 2003). Indiana bats were found foraging at two locations in the south end of the refuge. The refuge began conducting acoustical surveys in 2005. These surveys have documented three likely Indiana bat observations in the same location as the 2003 survey during 2005, 2007, and 2008. Additionally, acoustical surveys documented one new location for the species during 2007. Indiana bat calls have been documented from the refuge in the months of May, July, August, and September. It is probable that these bats were migrating and using the refuge as summer habitat for a maternity colony, since no known hibernacula occur within Canaan Valley. Because acoustical surveys are not 100 percent accurate and the Indiana bat has a call similar to the more common little brown bat, future surveys will include mist net operations to further document the use of the refuge by this endangered species.

Even though they are delisted, bald eagles are still protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act and remain a species of management priority for the Service. Bald eagles use the refuge primarily from late fall to early spring. Generally bald eagles observed are juveniles although adults are seen each year. Up to six bald eagles have been observed together on the refuge at one time. Typically eagles are seen singly during winter months foraging over the wetland areas in the northern portion of the refuge. No known nesting occurs in the vicinity of Canaan Valley.

State Listed Species

West Virginia does not have State threatened or endangered species legislation. However, the State does maintain a list of tracked wildlife and plant species. These are referred to as State species of concern and have been noted in previous sections where appropriate. Rare species are assigned ranks by the WVDNR Natural Heritage Program and global ranks by NatureServe.

Canaan Valley has at least 73 documented plants and 69 animal species recognized as either Federally threatened or endangered, or considered rare and ranked as a State species of concern. The number of rare animals documented on the refuge is expected to increase with continuing surveys of invertebrate species. The complete list of rare species known or expected to occur on the refuge is attached as appendix A.

Special Uses

Scientific Research

It is a Service policy to encourage and support research and management studies to provide scientific data which will help refuge staff develop appropriate management decisions on national wildlife refuges. Priority is granted to studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitats. All special use permits issued for research specify that they be conducted in a manner to cause minimal effects on wildlife and habitat. Canaan Valley refuge has consistently worked with a variety of university, State, and Federal entities on mutually beneficial research projects.

Public Access, Education and Recreational Opportunities

This section describes the public access, education and recreation opportunities at Canaan Valley refuge. See map 3-3 for existing public use opportunities on the refuge. Recreation features and access points on the refuge are available from the refuge website at *http://www.fws.gov/canaanvalley/CVNWR-trails.htm*.

The refuge does not have a visitor use plan. However, we implement many visitor opportunities and programs. Additionally, the refuge visitor's center was recently renovated to include new interpretive displays and landscaping to improve the visitors' experience. With the help of volunteers, the refuge has continued to improve trails on the refuge including the construction of an Americans With Disabilities Act compatible boardwalk on the Freeland Tract. A total of 31 miles of refuge roads and trails are maintained for priority public uses and are accessible by pedestrian (including cross-country skiing and snowshoeing), bicycling, and horseback. During winter months an additional 10 miles of commercially run cross-country ski trails are open as part of the White Grass Touring Center. Wildlife watching trails (including winter ski trails) provide year-round wildlife viewing opportunities to thousands of visitors annually.

The refuge has developed environmental education programs with the help of interns from local colleges and universities. Guest speakers are recruited for weekend programs. Refuge staff also provide a small number of programs, depending on their individual workloads.

Public Access

The refuge is open daily from one hour before sunrise until one hour after sunset. There are currently five access points for trails: Freeland Road, Forest Road 80, Cortland Road, Camp 70 Road and A-frame Road. Visitors may also float through the refuge by small watercraft, canoe, or kayak when water levels allow it. Refuge entrance and programs are currently all offered free of charge.

Wildlife-Dependent Recreation

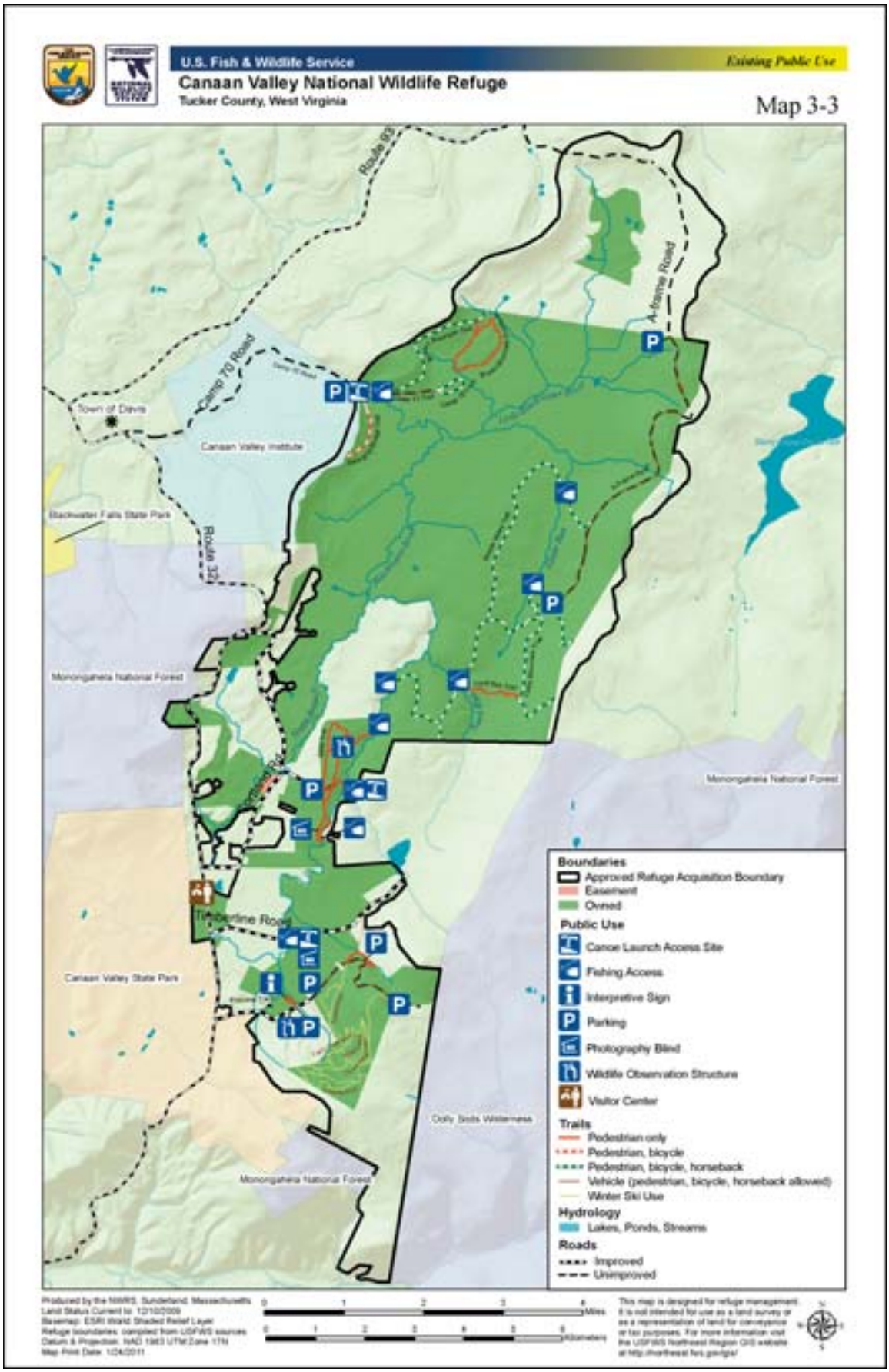
More than 20,000 people per year visit the refuge to participate in a variety of wildlife-dependent recreational and educational activities. These include wildlife observation, photography, interpretation, environmental education, hunting and fishing. A 31-mile road and trail system and Visitor Center support these activities.

Wildlife Observation and Photography

Wildlife observation and photography promote understanding and appreciation of natural resources and their management on all lands and waters in the refuge system. Per the 605 FW 4 and 5 policies, we strive to follow these guiding principles for wildlife observation and photography opportunities at the refuge:

1) Provide safe, enjoyable, and accessible wildlife viewing and photography opportunities and facilities;

2) Promote visitor understanding of, and increase visitor appreciation for, America's natural resources;


U.S. Fish & Wildlife Service
Existing Public Use
Canaan Valley National Wildlife Refuge
Tucker County, West Virginia
Map 3-3
Route 93
A-frame Road
Camp 70 Road
Town of Davis
Canaan Valley Institute
Blackwater Falls State Park
Route 32
Monongahela National Forest
Timberline Road
Canaan Valley State Park
Dolly Sods Wilderness
Boundaries
Approved Refuge Acquisition Boundary
Easement
Owned
Public Use
Canoe Launch Access Site
Fishing Access
Interpretive Sign
Parking
Photography Blind
Wildlife Observation Structure
Visitor Center
Trails
Pedestrian only
Pedestrian, bicycle
Pedestrian, bicycle, horseback
Vehicle (pedestrian, bicycle, horseback allowed)
Winter Ski Use
Hydrology
Lakes, Ponds, Streams
Roads
Improved
Unimproved
Miles
Kilometers

3) Focus on providing quality recreational and educational opportunities, consistent with Service criteria describing quality found in 605 FW 1 Part 1.10; and,

4) Minimize conflicts with visitors participating in other compatible wildlife-dependent recreation activities.

Mary Konchar

Wildlife photography

Although the refuge offers quality wildlife observation and photography experiences year round, the most popular seasons for this activity are summer and winter. The refuge's location, with its wildlife diversity and mosaic of habitats and trail access to those habitats, makes it a popular place for birdwatchers. In fact, Canaan Valley refuge is considered by many to be one of the best birding areas in West Virginia. The refuge's trail system currently offers a variety of opportunities for visitors interested in short or long trail segments and options for trail loops. Volunteers help to maintain the trails through the Adopt a Trail program administered by the Friends of the 500th. A boardwalk, constructed by the Friends of the 500th and the Youth Conservation Corps (YCC), provides access to a viewing platform overlooking a beaver pond and a stand of balsam fir for physically disabled visitors. Pedestrian trails are also available for cross country skiing. Currently, twenty-three miles of the trail system are open for bikes and twenty-two miles are open for horse-back riding. Dogs are permitted if kept on the trail and on a leash while on the refuge. Dogs may also be used for certain types of hunting. Wildlife observation is also conducted by refuge visitors entering the refuge by canoe or kayak. A detailed list of the different access points and trails on the refuge follows.

Freeland Road Access: Freeland Road provides access to two short pedestrian trails (Freeland Trail and Idleman's Run Trail) and to Forest Road 80 (FR80).

- *Freeland Trail (0.24 mi):* Nice views abound on the Freeland Trail. A short universally accessible boardwalk trail leads through a wet field to a spring-fed beaver pond. Around the pond, visitors may walk to a stand of balsam fir.

- *Forest Road 80 (2.0 mi):* Forest Road 80 is a maintained gravel road through forested habitat, including spruce forest at the summit. It is open for pedestrians, bicyclists, horseback riders, and licensed vehicles. It provides access from the valley to Dolly Sods Wilderness Area.

- *Idleman's Run Trail (0.39 mi):* A short pedestrian path runs through forest along Idleman's Run through a northern hardwood forest. Visitors can create a loop by walking down Forest Road 80 and returning to the parking area at the beginning of Idleman's Run.

Cortland Road Access: This provides access to the Beall (pronounced bell) trails. These trails are open for pedestrian use only. A total of 4.5 miles of trail can be hiked on Beall.

- *Beall North Trails (3.2 mi):* Beall north trails pass through forest, field and wet swale habitats, with a spur to a small bog and another spur to the Blackwater River.

- *Beall South Trails (1.3 mi):* Offer visitors good opportunities for viewing and hearing grassland birds, before dipping into the forest, down to the Blackwater River.

Camp 70 Access: Camp 70 Road (0.8 mi) leads to the Camp 70 Loop Trail, the Swinging Bridge Trail and the Brown Mountain Trails. The one mile section of Camp 70 Road that is on the refuge is currently a State road which has been unmaintained for many years. This section of road traverses the refuge and provides access to the Loop Trail at the end of the road.

- *The Camp 70 Loop Trail (2.8 mi round trip):* This trail travels east from the Camp 70 parking area. This extension of the State road is open for pedestrian, horse, bicycle and vehicle use, until the loop at the end, which is closed to vehicles. Traveling this trail, visitors start in the woods, and gradually the valley opens up before them. At the ending loop there are excellent views of the valleys, wetlands and close-up views of beaver ponds.

- *The Swinging Bridge Trail (1.1 mi):* This trail crosses the Blackwater River and provides access to refuge land on Canaan Mountain and connects to Canaan Valley Institute land which is also open for recreational use. This trail is open for pedestrian and bicycle access.

- *The Brown Mountain Trail (2.4 mi):* This trail is open to pedestrian, horse, and bicycle use. It is a pleasant trail through forest land, with a gently increasing grade. It leads to the Brown Mountain Overlook Trail (1.96 mi), a loop which provides a beautiful overlook of the refuge's wetlands. The Brown Mountain Overlook Trail is open for pedestrians only.

A-Frame Road Access: The rest of the refuge trails are accessible from A-frame Road.

- *A-frame Road (4.8 mi in the refuge):* This is a public access route open for pedestrian, horse, bicycle and vehicle use. From route 93 to the parking lot at the end of the gravel A-frame Road is nine miles, 4.8 miles through the refuge and 4.2 miles through private land. For most of its length the road passes through the forested slopes of Cabin Mountain. In a few places, there are nice "overlook" views of the refuge. The primary parking area is near the beaver ponds along Glade Run. Parking is also permitted on the side of the road, wherever it does not impede traffic.

- *The Valley Overlook Trail (0.06 mi):* This is a short steep climb from A-frame Road, shortly after the road enters the refuge, to a clearing on the slope of the northeastern side of the refuge. On a clear day, visitors experience a beautiful view of the entire valley from this spot. The refuge currently wants to re-route the trail to reduce its gradient, making it accessible for more visitors. This trail is open to pedestrians.

- *The Cabin Mountain Trail (2.0 mi):* This trail begins at the A-frame Road parking area. It also provides access to Sand Run Trail. It begins with views of the Glade Run beaver ponds, then travels through forest habitat. Excellent views of the refuge and the entire Canaan Valley can be seen from the summit of this trail. This trail is open to pedestrian, horse, and bicycle use. A variety of forest birds and wildlife can be encountered on this trail.

- *Cabin Mountain Spur (0.7 mi):* This trail begins at the parking lot at the end of A-Frame Road. It travels through forested habitats to overlooks on Cabin Mountain. The overlook on Cabin Mountain Spur is on private land, after leaving refuge land. Visitors should have the permission of the landowner before traveling there. This trail is open to pedestrian, horse, and bicycle use.

- *Sand Run Trail (0.94 mi):* Sand Run Trail starts off of Cabin Mountain Trail. The trail goes through forested habitat down to the valley floor, travels through wetlands, crosses a stream and rises to meet Middle Valley Trail. This trail is open to pedestrian use only.

- *South Glade Run Crossing (0.9 mi):* This trail starts shortly after Cabin Mountain Trail starts its gradual climb. This trail is similar to Sand Run trail in that it goes through forested habitat, wetlands, and crosses Glade Run, then rises to meet Middle Valley Trail. This trail is open to bicycle, horseback, and pedestrian use.

- *Middle Valley Trail (6.2 mi):* The south end of Middle Valley Trail meets the border of Timberline residential community. The north end of the trail turns east, crosses Glade Run, then travels uphill to A-frame Road. Middle Valley Trail provides an opportunity to experience the refuge's wetlands, grasslands, and forests. Alder thickets, which attract a variety of unique plant and animal species, can be viewed on the northern portion of the trail. This trail is open to pedestrian, horse, and bicycle use.

- *Blackwater View Trail (1.4 mi):* The Blackwater View Trail begins near where the Middle Ridge Trail borders the Timberline residential community. It then travels down the slope of Middle Ridge to the Blackwater River. This trail is open to pedestrian, bicycle, and horseback use.

Interpretation

The refuge's interpretive mission is as follows: By interpreting the biological treasures entrusted to the refuge's care, visitors will understand what we do and be motivated to play an active role in environmental concerns here and at home.

A new visitor center was opened to the public in summer 2001. The visitor center has an interpretive exhibit room with displays that focus on the Canaan Valley, the Service and the Refuge System. A 20-person audio/visual room, with full audiovisual capacity, is used for the Refuge Orientation Video, special events, lectures, and training sessions. New exhibits were installed in 2006, and a native plant garden was installed for outdoor interpretation in 2007. In fiscal year 2008, the visitor center was open 234 days, serving 5,778 visitors.

The visitor center is open Monday, Wednesday, and Friday from 8:30 am to 3:00 pm, and on Saturday from 10:00 am to 4:00 pm, as staff and volunteers are available. During the peak summer season the visitor center is generally open seven days a week, depending on the availability of interns and volunteers. When available, trained refuge volunteers staff the information desk, answer questions, hand out brochures, and sell items from the cooperating association sales outlet. The Friends of the 500th, a non-profit support group, operates the sales outlet and helps support refuge projects and programs.

Refuge staff and volunteers conduct special events throughout the year to help people learn more about, and contribute to management of the refuge's fish and wildlife resources. Offsite events include booths at the Mountain State Forest Festival, Hooked on Fishing Not on Drugs (HOFNOD) Expo, and the Tucker County fishing derby. Onsite special events include Woodcock Round-up for Earth Day, Migration Bird Count for International Migratory Bird Day, Wild School day for children, and the Valley Vibes Program, a monthly program for families on the local area's natural history. The refuge also hosts a variety of volunteer work days for fence removal, tree planting, and a Christmas Bird Count. In 2008, volunteers contributed 702 hours to these special events.

Interpretive tours are given to help visitors learn more about the refuge's fish and wildlife resources. The refuge also partners with White Grass to provide environmental education and interpretive tours during the winter months. Tours and programs are led by staff, volunteers, or researchers on the refuge. In Fiscal Year 2008, 55 on-site interpretive programs served 822 visitors. This includes 35 interpretive walks on the refuge, with 408 people attending, and 20 indoor interpretive programs, with 414 participants attending.

Fishing

Per the 605 FW 3, we strive to follow these guiding principles for recreational fishing opportunities at the refuge:

1) Effectively maintain healthy and diverse fish communities and aquatic ecosystems through the use of scientific management techniques;

2) Promote visitor understanding of, and increase visitor appreciation for, America's natural resources;

3) Provide opportunities for quality recreational and educational experiences consistent with criteria describing quality found in 605 FW 1.6;

4) Encourage participation in this tradition deeply rooted in America's natural heritage and conservation history; and

5) Minimize conflicts with visitors participating in other compatible wildlife-dependent recreational activities.

A compatibility determination was completed and approved in 2003 for fishing on the refuge. Current numbers of anglers using the refuge is estimated at 550 per year. The most popular locations for fishing access include the Blackwater River (along Timberline Road and Rt. 32) and beaver ponds in the north end of the valley.

Anglers must have a valid State license to fish on the refuge. Anglers can access rivers, streams, or ponds wherever a road or trail intersects these waterways. Most anglers fish for trout. Fishing activity is highest after the State stocks rivers and streams.

Hunting

The refuge first opened for hunting in 1996. The most recent Hunt Plan and Environmental Assessment were revised in 2007. The refuge prepares annual hunt programs, seeks State review, and makes revisions to the refuge hunt program when necessary. For example, in 2002 the refuge began requiring hunters to obtain refuge hunting permits on an annual basis. The hunt program is managed to meet refuge priority public use goals, and manage deer populations. See map 3-4 for the existing refuge hunt map.

Approximately 98 percent of the refuge is currently open to hunting, with most seasons following the State seasons. Areas closed to hunting follow the original 1996 hunt plan and most tracts in the southern portion of the refuge are closed to rifle hunting due to community safety concerns.

The following are guiding principles of the hunting program, according to new Fish and Wildlife policy (605 FW 2):

1) Manage wildlife populations consistent with Refuge System-specific management plans approved after 1997 and, to the extent practicable, State fish and wildlife conservation plans;

2) Promote visitor understanding of and increase visitor appreciation for America's natural resources;

3) Provide opportunities for quality recreational and educational experiences;

4) Encourage participation in this tradition; and

5) Minimize conflicts with visitors participating in other compatible wildlife-dependent recreational activities.

Hunting is permitted in accordance with State seasons and regulations, Federal laws, and refuge-specific regulations. Except for spring turkey season, the refuge is closed to hunting from March 1 to August 31. The refuge began issuing formal hunting permits during the 2002 season after the acquisition of the Main Tract. An annual average of 1,819 refuge hunt permits has been issued since the 2002 season. In fiscal year 2007, hunters spent an estimated 690 hunter-days on the refuge.

The following game species may be taken on refuge lands during applicable seasons: white-tailed deer, black bear, wild turkey, ruffed grouse, mourning dove, waterfowl, coot, rail, gallinule, snipe, woodcock, rabbit, hare, squirrel, red fox, gray fox, raccoon, bobcat, woodchuck, coyote, opossum, and striped skunk. All other species of wildlife are protected. Hunters must carry a valid State hunting license, refuge hunt permit and a photo ID to hunt on the refuge.

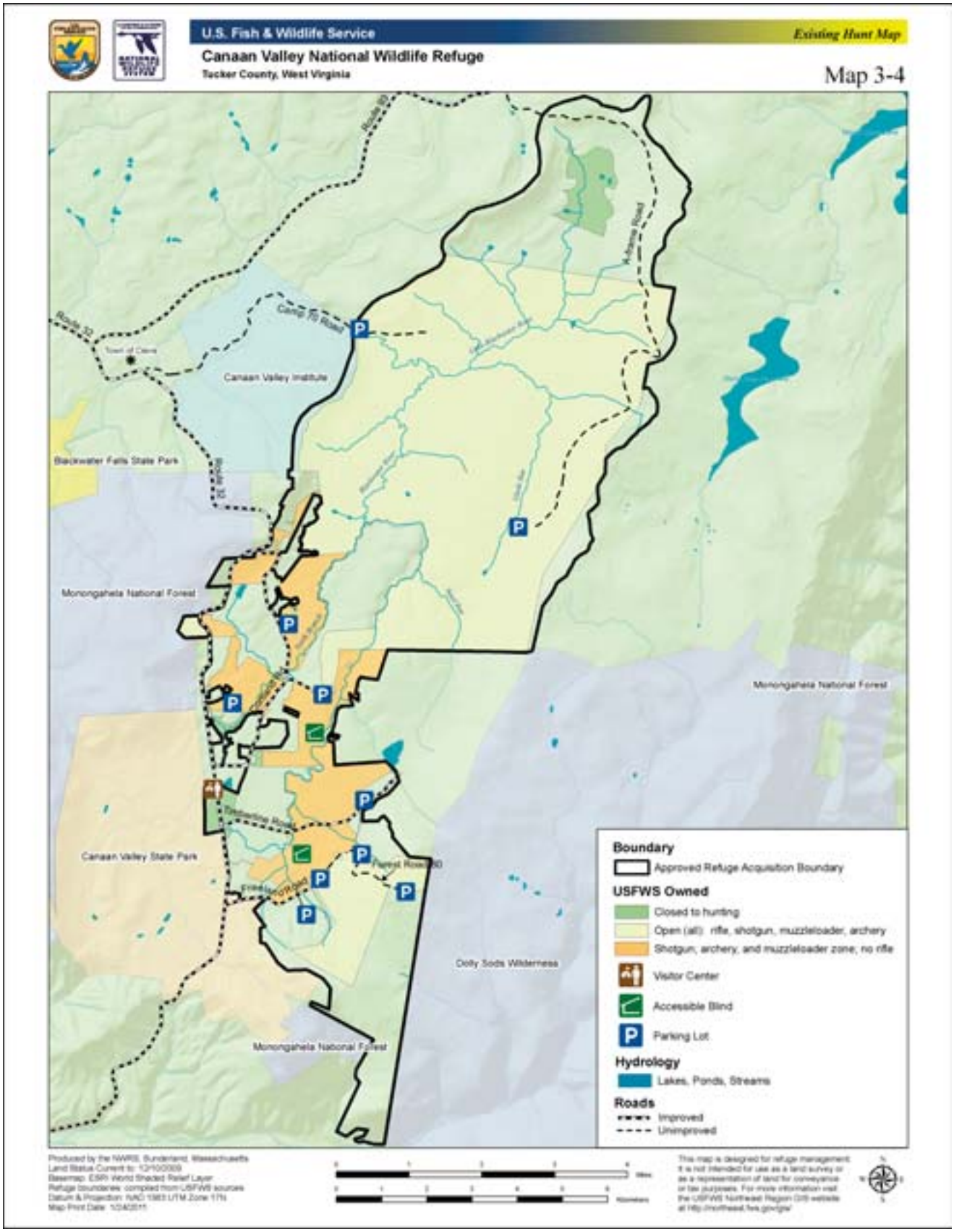
Dog training and field trials are not permitted on the refuge. However, hunting dogs are permitted for raccoon, grouse, woodcock, and black bear hunting seasons, according to State and refuge specific regulations.

Environmental Education

Per the 605 FW 6, we strive to follow these guiding principles for environmental education opportunities on the refuge:

1) Teach awareness, understanding, and appreciation of our natural and cultural resources and conservation history.

2) Allow program participants to demonstrate learning through refuge-specific stewardship tasks and projects that they can carry over into their everyday lives.


U.S. Fish & Wildlife Service
Existing Hunt Map
Canaan Valley National Wildlife Refuge
Tucker County, West Virginia
Map 3-4
Route 32
Route 93
Camp 70 Road
Town of Davis
Canaan Valley Institute
Blackwater Falls State Park
Blackwater Falls Rd
Monongahela National Forest
Monongahela National Forest
Monongahela National Forest
Canaan Valley State Park
Timberline Road
Forest Road 80
Dolly Sods Wilderness
Boundary
Approved Refuge Acquisition Boundary
USFWS Owned
Closed to hunting
Open (all): rifle, shotgun, muzzleloader, archery
Shotgun, archery, and muzzleloader zone; no rifle
Visitor Center
Accessible Blind
Parking Lot
Hydrology
Lakes, Ponds, Streams
Roads
Improved
Unimproved

3) Establish partnerships to support environmental education both on- and off-site.

4) Support local, State, and national educational standards through environmental education on refuges.

5) Assist refuge staff, volunteers, and other partners in obtaining the knowledge, skills, and abilities to support environmental education.

6) Provide appropriate materials, equipment, facilities, and study locations to support environmental education.

7) Give refuges a way to serve as role models in the community for environmental stewardship.

8) Minimize conflicts with visitors participating in other compatible wildlife-dependent recreation activities.

The refuge maintains a small environmental education program. Teachers and youth group leaders may make reservations to bring classes to the refuge for environmental field trips. Staff or volunteers assist with school field trips as time and schedules permit. Teachers may also lead their own field trip, tying in field activities to what the students are learning back in the classroom. The Friends of the 500th help schools pay for buses for student field trips to the refuge.

The refuge environmental education programs reach many area school children. In 2008, 345 students attended on-site programs and 153 students attended off-site programs.

Marquette Crockett/USFWS

First grade field trip, Freeland Tract

The refuge partners with a local group, Tucker County Connections that hosts a three-day camp for County's fifth grade students. The goal of the camp is to connect local students with their environment through interactive educational programs related to local culture, human and natural history. The refuge hosts a field trip for the fifth graders as part of their three day camp. Refuge staff also helps with other activities as schedules permit.

The refuge provides environmental education programs for the local Girl Scout day camp, located at Blackwater Falls State Park. Each year, the Girl Scouts focus on two badges related to nature and outdoors that they work on during the three days of camp. Staff works with the park naturalist to plan and present activities for the Girl Scouts to meet the badge requirements related to natural history and the environment.

The refuge also presents a one day program called Wild School Day to educate the County's sixth grade students about fish and wildlife. Ten to twelve stations teach students about fishing skills, aquatic habitats, boating, raptors, snakes, birds, and more. The whole refuge staff gets involved, as do staff from the WVDNR, the USFS (Monongahela National Forest), Canaan Valley Institute, and refuge volunteers.

Teachers and youth leaders may borrow curriculum materials from the refuge library to help them prepare lessons about the environment both at school and on field trips. Currently the Friends of the 500th are working to catalog library materials. Once cataloged, the Friends will advertise the availability of materials in the library.

Cultural Resources

Service cultural resource staff in the regional office review construction projects and changes to buildings on the refuge for potential to affect archeological sites and historical structures. The Service consults with the West Virginia Department of Culture and History (the West Virginia State Historic Preservation Office [SHPO]) in compliance with the National Historic Preservation Act during these projects. In preparation for the CCP, the Service prepared archaeological overviews for the refuge. These include pre-contact period archaeological sensitivity maps and a field reconnaissance by the Tucker County Highlands History and Education Project that yielded historic archaeology site inventory forms, locations, and descriptions for historic period resources on the refuge. Structures over 50 years old are inventoried and evaluated by an architectural historian as needed.

Four archaeological surveys have been conducted on lands the refuge now owns. Two of these were field surveys in areas once proposed for construction projects. In 1995, Cultural Resource Analysts, Inc. conducted a survey involving field testing for a planned resort expansion now included in refuge ownership. This survey identified the historic Freeland farmstead building sites, including the house, springhouse, storehouse, and privy. Census records showed that in 1880, James Freeland, who came to Canaan Valley in 1872 as one of the first settlers, with Isaac and Manerva Freeling (sic.) lived in the house with Isaac and Manerva's two daughters. A third child died in 1889.

In 2002, Mid-Atlantic Archaeological Research located the only known prehistoric archaeological site on the refuge. This prehistoric site yielded sparse chert flakes and a biface fragment in shovel pits. These results were interpreted as showing evidence of an ephemeral camp or resting spot as people hunted or sought other resources. The Service altered the location of the proposed building project to an area which contained no archaeological sites.

A third small project-oriented survey by Service staff revealed no sites during subsurface testing.

In addition to these archaeological field surveys, a prehistoric archaeology overview was contracted to Michael Baker Jr., Inc. in 2007. The reconnaissance overview study, "Prehistoric Archaeological Background Study for a Comprehensive Conservation Plan of Canaan Valley National Wildlife Refuge, Tucker and Grant Counties, West Virginia," included no field work. The report contains palaeoenvironmental information about the refuge and develops a model of prehistoric site location. Using variables such as slope, historic disturbance and distance to water, a map of high and medium potential sites for prehistoric resources was created. However, the report notes that due to the extensive timbering, farming and fire history of Canaan Valley, many sites on the valley floor may be heavily disturbed. The greatest potential for preserved prehistoric sites may be under the relatively recently formed peat deposits. These sites would not be found through shovel test pits.

A corresponding overview of historic settlement and development has been produced for the CCP by a committee of the Friends of the 500th, the Tucker County Highlands History and Education Project (TCHHEP). This overview summarized the early settlement and development of Canaan Valley by European Americans and included a field component. The work of TCCHEP identified 76 sites on or near refuge land which were considered potential historic archaeological sites. A subset of these sites was investigated in detail, and all were recorded and identified in a report submitted to the refuge in 2007. One example of the work documented in the report is a grave site located in a wooded section of the Main Tract. Investigations by the TCHHEP found that the general

location was the home site of George W. Leatherman. According to TCHHEP, Leatherman was a very early settler of Canaan Valley purchasing land totaling over 2,300 acres in 1875. The grave includes a head and footstone formed from sandstone slabs. The headstone indicates the burial of G.S.L. in 1880 and could be the oldest grave in Canaan Valley. This document will prove invaluable for avoiding negative impacts to historic resources during habitat management and visitor services development at Canaan Valley National Wildlife Refuge.

Ken Sturm/USFWS

A headstone belonging to a member of the Leatherman family and located on refuge-owned land.